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INTRODUCTION

This report includes abstracts and bibliographic lists on major contractual subjects that were completed in September, 1972. The major topics are: laser technology, effects of strong explosions, geosciences, and particle beams. A section on material science has been included as the optional fifth topic, as well as a section on items of miscellaneous interest.

Only laser entries concerning high-power effects are routinely covered in the monthly reports; in addition the present issue includes a number of selected articles on dye lasers.

An index identifying source abbreviations and an author index to the abstracts are appended.

Details of illustrations in this document may be better studied on microfiche.

TABLE OF CONTENTS

1. Laser Technology

A. Abstracts

Askar'yan, G. A., and S. D. Manukyan. Acceleration of particles by a moving laser focus, focusing front, or ultrashort laser pulse front. ZhETF, v. 62, no. 6, 1972, 2156-2160.

An analysis is given of several ways in which the high field gradient in a laser pulse can be used to accelerate electrons or ions in a controlled fashion. If the mean force exerted on a particle in an e-m field of amplitude E_o (r) and frequency ω is expressed as

$$f = -\frac{e^2}{2m\omega^2}\nabla(E^2)_{mean}$$

then it can be shown that, for example, a neodymium laser generating nanosecond pulses in the 30 Gw range will produce an effective field E_{eff} of approximately 1 Mv/cm, while a picosecond pulse of 3 x 10^3 Gw will yield 100 Mv/cm. Gradients of this magnitude when given a controlled lateral displacement (swept beam) or axial displacement (change in focal point or beam divergence) can in theory be used for selective particle acceleration. One method for doing this would be programmed refocusing of annular portions of the laser wavefront, using corresponding portions of a focusing lens; another would be a programmed refocusing of the beam along a selected path. In the latter case it is shown that a channel with reduced nonlinear absorption can be generated for charged particle motion. In the case of low coulomb attraction between electrons and ions, electrons would essentially be accelerated as if free; at sufficiently high coulomb forces an ion acceleration component would appear. In conclusion the authors suggest that the moving-focus technique could be extended to provide macroscopic particle acceleration (cf. Askar'yan et al. Light-reaction acceleration of macroparticles of matter. ZhETF P, v. 5, no. 8, 1967, 258-260)

Semenova, V. I. Electromagnetic wave reflection during oblique incidence on a moving ionization front. IVUZ Radiofiz, no. 5, 1972, 665-674.

An extensive theoretical analysis is given of the interaction of a monochromatic wave with a plasma boundary. The particular case considered is of inclined incidence of monochromatic TE and TM waves upon a sharply defined boundary of a plasma half-space, where the plasma is generated by ionizing radiation acting on a neutral gas. For simplicity the incident pulse is assumed arbitrarity narrow and the dielectric constant outside the plasma is taken to be unity. It is shown that with the E-field normal to plane of incidence, the solution for the inclined incidence case is essentially the same as for normal incidence. With the TM wave, however, inclined incidence is shown to generate two axial waves in addition to the transverse ones, at any given frequency of the incident wave. Formulas for the reflection and transmission of the latter are obtained and analyzed in terms of the idealized plasma parameters.

Kuznetsov, A. Ya., I. S. Varnasheva, A. A. Poplavskiy, and G. P. Tikhomirov. Destruction of reflective dielectric coatings by laser radiation. OMP, no. 3, 1972, 39-42.

The resistance of reflective coatings to laser radiation was studied using zinc sulfide and magnesium fluoride coatings. The coatings were applied by thermal evaporation in a vacuum, and the reflection factor was $R = 90\%$ at $\lambda = 0.7\,\mu$. The flux falling upon the specimen was controlled

by glass filters at a constant radiation energy of a single-pulse multi-mode ruby laser, with a $\approx$ 40 nsec pulse duration. The purpose was to find the number of bursts the coating would endure at various energy-density values below the limit value, i.e., to find the threshold of destruction for multiple radiation effects. The reference threshold of destruction was the number of bursts n at which the mirror transmissibility increased by 30%. The energy density limit (threshold of destruction) at which the coating was destroyed with one burst was also measured. The reference density criterion in this case was the appearance of plasma, recorded photoelectrically or visually.

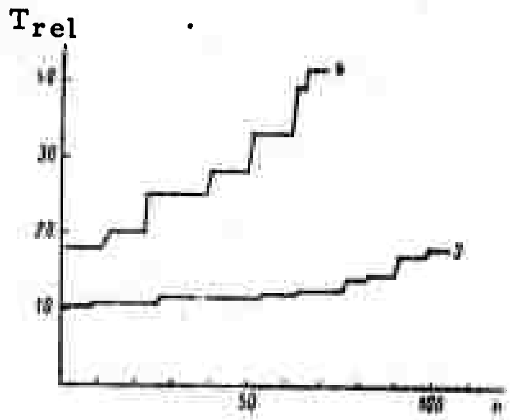


Fig. 1. Transmissibility variation in relative units for multiple radiation effects on two coatings.

Experimental relationships for the threshold energy density W, at which destruction begins at the n-th burst as a function of the number of exposures n, are presented in Fig. 2.

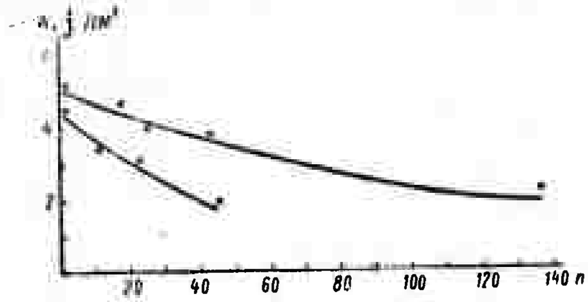


Fig. 2. Threshold characteristic,x- experimental values up to n = 140

The values in Fig. 2 are approximated by a function of the type

$$W_n = W_1 \times e^{-\beta(n-1)},$$

where W_1 is the threshold of destruction for one burst, W_n is the threshold of destruction for n bursts, and n is the number of bursts. The coefficient β for coatings produced by the same technique is 0.0080-0.0160. This ratio is an approximate one since it was determined for n = 140; however, it can be seen from (1) that the relationship of the destruction threshold to the number of bursts is cumulative. Although the coating properties for β were not determined, this value is always higher for coatings with a one-burst lower destruction threshold. Coating transmissibility increases substantially with a burst increase prior to the appearance of plasma (Fig. 1), although coating destruction is not observed visually. Electron-microscope observations show that, prior to the plasma appearance, the transmissibility increase is accompanied by microdestruction of the coating surface, which increases with the number of bursts. This form of destruction begins even before the change of coating transmissibility.

Assuming the destruction process is a thermal one at the absorption centers (microimperfections), a formula is presented for determining the index of absorption of the microimperfections, together with an example of its application.

Kantorovich, I. I. Frequency dependence of optical breakdown in gases. ZhPS, v. 16, no. 4, 1972, 605-610.

An analysis is given of the contribution of atomic excitation processes, particularly avalanche ionization, to optical breakdown in gas. The study is generally limited to the area around breakdown threshold, $\sim 10^6$ v/cm, with argon and xenon used as hypothetical media. Expressions are derived for the probability $f(\omega)$ of continuous ionization of Ar and Xe, and these results are plotted in Fig. 1.

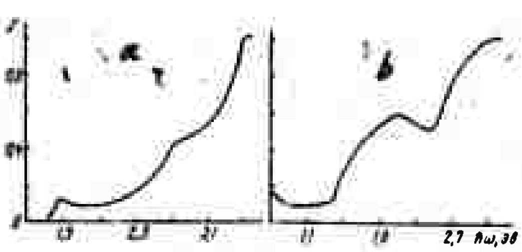


Fig. 1. Frequency dependence of ionization probability for Ar (a) and Xe (b). ω = optical frequency.

Breakdown threshold vs. beam frequency is shown in Fig. 2, which

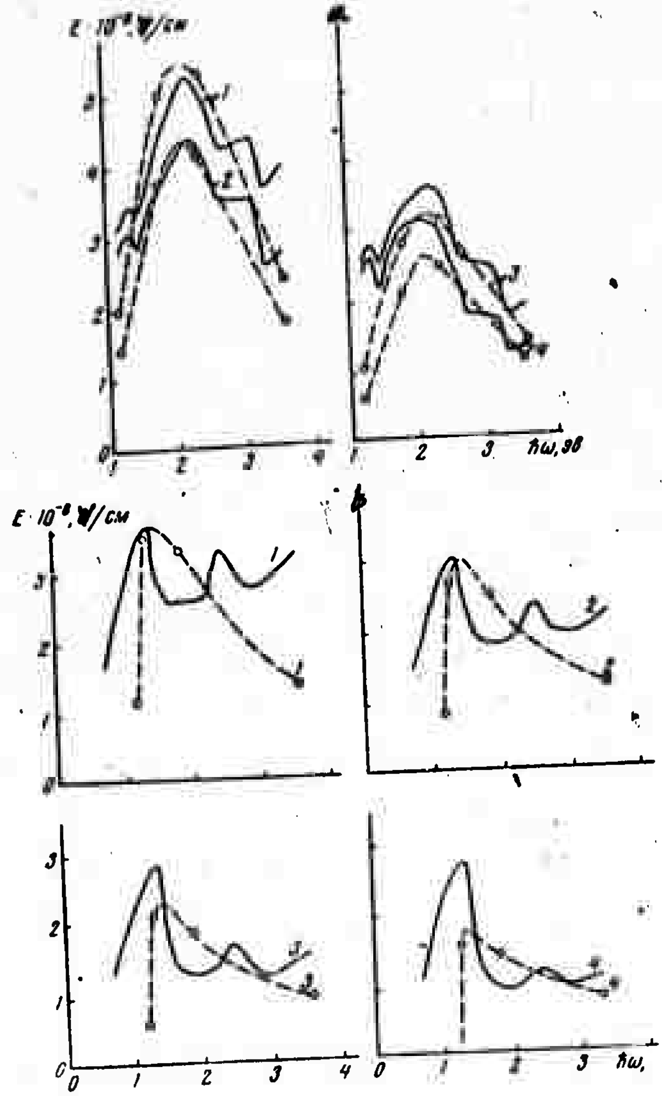


Fig. 2. Frequency dependence of breakdown threshold in Ar (a) and Xe (b) at pressures of 1000 (1); 2000 (2); 4000 (3) and 8000 torr (4). Solid line - theory; dashed - experiment.

compares theory with earlier experimental results. The divergence seen at lower frequencies and higher pressures is ascribed to increased multiphoton ionization probabilities owing to local nonuniformity.

Kuznetsov, A. Ye., A. A. Orlov, and P. I. Ulyakov. Pulsed regime for vaporizing optical materials by CO_2 laser radiation. IN: Sbornik. Kvantovaya elektronika, Moskva. no. 7, 1972, 57-60.

An analysis is given of experimental results on the interaction of CO_2 laser radiation ($\lambda = 10.6\mu$; constant power density = $(0.5-2)\ 10^4 w/cm^2$) with a series of optical materials, as reported by Bubyakin et al (FIAN, 1969, 34p), where a shielding effect in the evaporation process of the substance and cavity formation were noted. Time characteristics of cavity depth ℓ_k and the length of the luminous part of the flare ℓ_f forKV quartz glass are plotted in Fig. 1. The evaporation displays a clearly

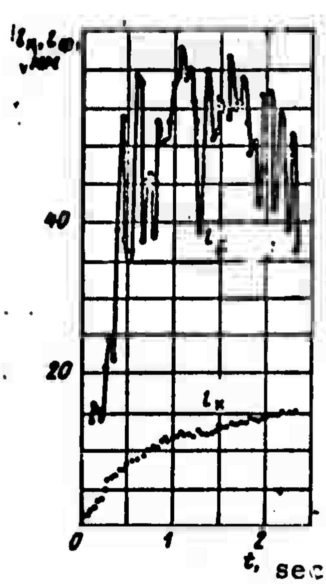


Fig. 1. Relationship of cavity depth ℓ_k and flare length ℓ_f to irradiation time for quartz glass ($q = 1.9x10^{14}/cm^2$)

pulsating character with an irregular oscillating frequency of 5-10 Hz. Average deepening rates in the pulsating period and in steady-state evaporation are tabulated for various materials. This qualitative characteristic was observed in all experiments, with quartz as well as with other optical materials. The only variation was in the pulsation amplitude and the steady-state regime discharge time. Two main processes, namely gaseous phase dispersion and emission shielding lead to the pulsating nature of cavity formation. The pulsation damping of LK-5, K-8 and other glass types occurred more rapidly than with quartz glass. A steady self-adjusting evaporation regime was observed through to the complete piercing of a 60 mm thick quartz specimen, and with splitting of other materials. The pulsating nature of the process up to the self-adjusting regime is apparently common to all substances. The damage products of these substances also exhibit absorptivity at the active irradiation frequency. The authors conclude by giving a system of approximate equations for the dynamic low-temperature evaporation of dielectrics, taking vapor absorption into account.

Volosevich, P. P., and Ye. I. Levanov. <u>On self-similar motions of a two-temperature plasma</u>. IN: Sbornik. Teplo- i massoperenos, v. 8. Minsk, 1972, 29-35. (RZhMekh, 9/72, no. 9B119) (Translation)

A self-similar solution is analyzed to the problem of dispersion of an ionized gas in vacuum, occurring from a laser-target interaction. The case is considered for a powerful laser source interacting with a plane solid surface. The plasma is treated as a two-

temperature hydrodynamic approximation, taking into account the energy exchange between electrons and ions; electron thermal conductivity; and ion drag. The self-similar solution has the form of a temperature wave propagating through a given "noise" level at a finite velocity. Between the temperature wave front and the vacuum-target interface a shock wave occurs, at whose front the electron temperature is continuous while the hydrodynamic parameters and ion temperature undergo discontinuities. At the target face the ion component of temperature goes to zero, while the electron component has a non-zero value. Calculations show that there are two distinct modes of heat propagation, namely subsonic and supersonic.

Barmin, A. A., and A. G. Kulikovskiy. <u>Boundary conditions at the surface of a discontinuity, occurring from the interaction of powerful radiation with metal.</u> IN: Sbornik. Nauch. konf. In-t mekh, Mosk. universiteta, Moskva, May 22-24, 1972. Abstracts of papers. Moskva, 1972, 7. (RZhMekh, 9/72, no. 9B920) (Translation).

The structure is studied of the narrow transition zone which appears upon the interaction of powerful beamed radiation with metal, for the case in which the incident radiation is entirely absorbed. A complete system of boundary conditions is obtained for the surface discontinuity which is used to model the transition zone.

Nikiforov, Yu. N., V. A. Yanushkevich, and A. V. Sandulova. Change in electrical properties of p-Si crystal whiskers from the action of giant laser pulses. FiKhOM, no. 3, 1972, 132-134.

Laser-induced change in the resistivity ρ of p-Si whiskers is described. The whiskers were grown along the [111] axis, had a hexagonal cross section, and ranged in length from 3 to 7 mm. Specimens were exposed to 50 nsec giant pulses from a ruby laser, with the laser beam normal to the crystal axis. Impact densities were varied over several tens of joules/cm^2, up to the damage threshold which was in the range of 35 - 45 j/cm^2. The data are presented as resistivity variation $\Delta R/R_0$ in exposed specimens as functions of whisker geometry, ambient temperature and initial ρ. Typical results at an exposure of 22 j/cm^2 show a sharp rise in R by about 12-15%, followed by an exponential decay back to about the initial value, at a time constant $\cong$20 milliseconds. Of the possible mechanisms considered for the alteration effect (photoeffect, crystal heating, piezoeffect, defect formation) it is shown that point defect formation is the most probable factor. Defect levels, estimated to reach 10^{17}/cm^3, were effectively annealed out in all cases in 30 milliseconds or less.

Boyko, Yu. I., and A. K. Yemets. Study of laser self-focusing in alkali-halide single crystals, according to data on shift of the damage center. DAN, v. 206, no. 2, 1972, 319-322.

Experimental results are described of laser damage phenomena in KCL and KBr crystals, with the object of determining the

extent and effect of self-focusing in the crystal. A free-running Nd glass laser was used developing 100 μsec pulses to a maximum of 16 j. Target specimens were parallelepipeds 30x30x100 mm; the laser beam entered normal to an end face as shown in Fig. 1, using a lens with f = 55 mm.

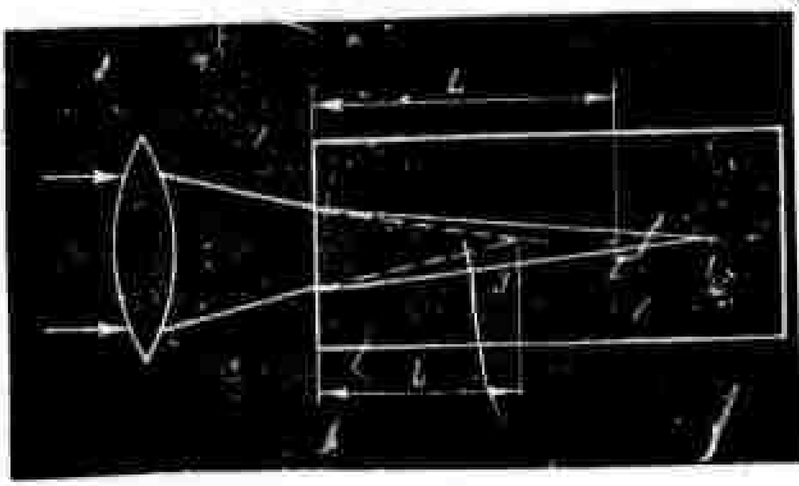


Fig. 1. Configuration for self-focusing experiment.

Results were analyzed in terms of the actual distance L of beam focus from the entrance face, and lens focal distance ℓ (Fig. 1). In the absence of nonlinear effects the approximate linear relation $L \cong n_o \ell$ should apply, where n_o = nominal refractive index; this proved to be the case for KCL, whereas for KBr the damage center was found to shift toward the laser source such that $L \sim \ell^2$. The effects are compared in Fig. 2, showing the

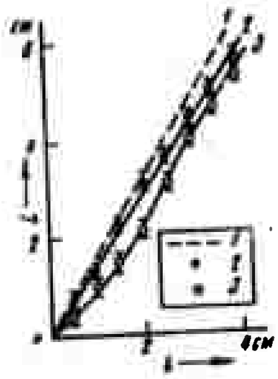


Fig. 2. Shift of damage center vs. lens focal distance
1 - calculated for KBr; 2 - KCl; 3 - KBr, actual

nonlinear self-focusing response of KBr. The latter effect suggests a thermal mechanism, which was confirmed by further tests on KBr specimens in a heat chamber in which $n_o(T)$ as well as $dn_o/dT(T)$ were measured. This showed that at 0.6 T_{fusion} and above, dn_o/dT takes on positive values which would account for the observed self-focusing in KBr.

Uglov, A. A., A. A. Zhukov, A. N. Kokora, M. A. Krishtal, and M. Kh. Shorshorov. "Shift" of critical points under laser heating of carbon-iron alloys. FiKhOM, no. 2, 1972, 3-8.

The "shift" of critical points in steel heated by a laser beam is analyzed. Allowance is made for nonuniform distribution of specific heat flux on the metal surface, and hence different volumetric heating rates. Under conditions of rapid heating and cooling rates, as in metal treatment by a laser beam, "shift" of critical points becomes important in micrographic determination of temperature within the metal after cutoff of the laser pulse. Using a theoretical formula, numerical data were obtained for heating rates $dt/d\tau$ in ShKh15 perlitic steel at various depths z and distances r from the center of a beam spot on the metal surface. Concentration coefficient $k = 80\ cm^{-2}$ was used in calculations of power density distribution on the surface. The calculated $dt/d\tau$ versus r plots (Fig. 1) show that, at $q_o = 0.92 \times 10^5\ w/cm^2$, $dt/d\tau$ =

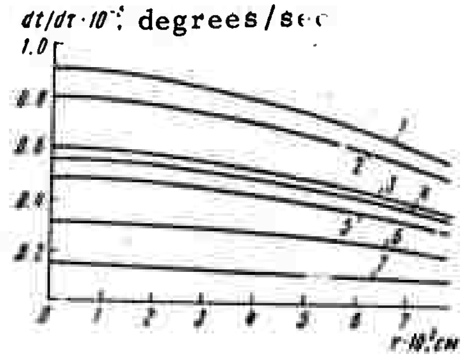


Fig. 1. Heating rate of ShKh15 steel by laser pulses of 0.5 millisec width versus r at z(cm) = 3.10^{-3} (1), 2.10^{-3} (2), 1.10^{-3} (3), 5.10^{-3} (4), 0 (5), 6.10^{-3} (6), and 7.10^{-3} (7).

10^5 degrees/sec, and that $dt/d\tau$ can vary by a factor of five in the region where temperature may exceed the perlite-to-austenite transformation point (A_1). At the cited $dt/d\tau$, the shift t_x of point A_1 for ShKh15 steel was calculated to be ~ 200° C from

$$t_x = \left(\frac{k_1^2 x^2}{4\bar{D}}\right)^{1/3} \cdot v^{1/3}$$

where k_1 = 110 degrees is the angular coefficient determined from the $Fe-Fe_3C$ phase diagram; $\nu = 0.5 \times 10^5$ deg/sec is the heating rate in the critical temperature range, and $\bar{D}$ is the coefficient of carbon diffusion in austenite. The maximum Tx variation due to difference in v within the metal was 1.7. It was concluded that steel of a complex composition is not suitable for a study of temperature fields under conditions of a very rapid heating. In view of this conclusion, a micrographic study was made of type 45 and U8 hypoeutectoid carbon steels in a surface area casehardened by laser radiation. The micrographs show that the temperature range of A_1 transformation is enlarged up to the liquidus, and the A_3 transition point practically disappears with the ferrite lattice coexisting with melted austenite. A sample result of U8 steel exposure is shown in Fig. 2.

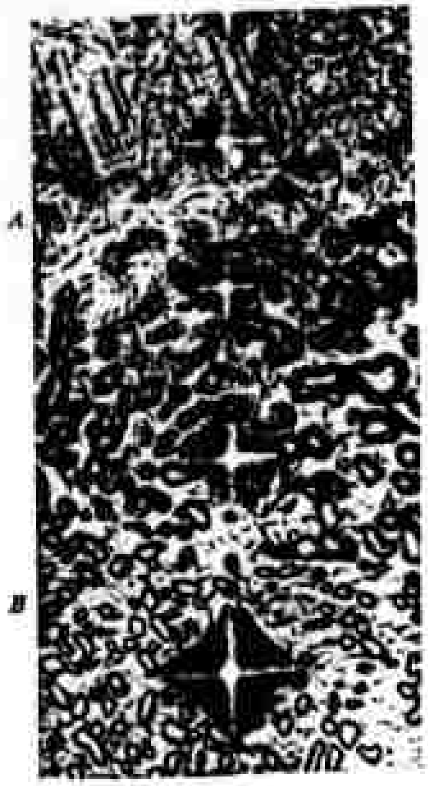


Fig. 2. Microstructure of type V8 steel with a perlite structure in the laser heating zone. A- fusion boundary; B- limit of thermally affected zone. (X 1300)

Gusev, V. K., G. M. Malyshev, G. T. Razdobarin, and L. V. Sokolova. Measuring electron temperature and concentration from laser scattering by plasma in the Tuman-2. ZhTF, no. 2, 1972, 340-343.

A laser diagnostic technique for measuring plasma parameters in a Tuman-2 torus is described in detail. The method was based on recording scattered radiation from a current-heated plasma at an angle of 140°, as shown in Fig. 1. The ruby was Q-switched by a KDP cell

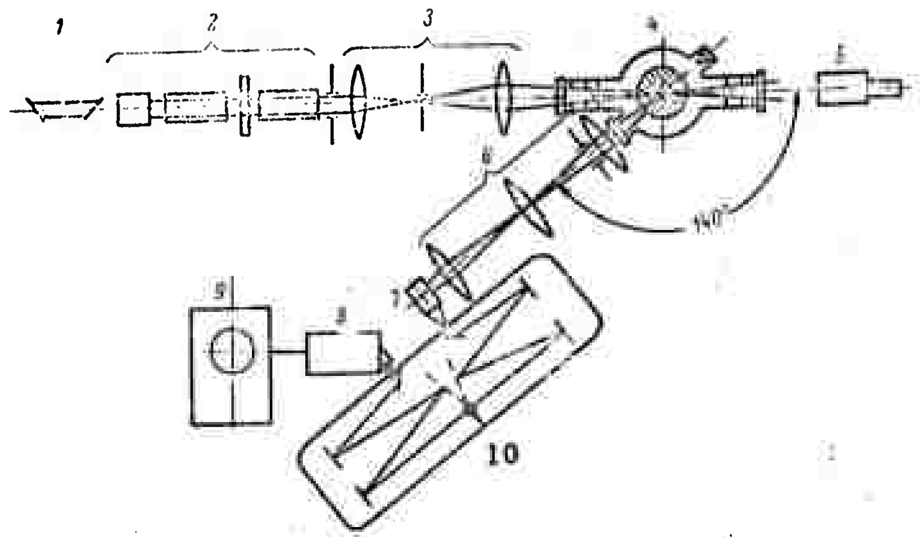


Fig. 1. Plasma diagnostic experiment
1- He-Ne alignment laser; 2- two stage ruby; 3- focus optics; 4- plasma chamber; 5- TB-3 theodolite; 6, 7- projection optics; 8- photomultiplier; 9- CRO; 10- DFS-12 dual monochromator.

to give 1.5j, 30 nsec pulses; an optical absorber was installed opposite the laser entrance port to minimize parasitic scatter effects. With this configuration the scattering spectra were registered for discharge pulses of 4.5 and 9 ka, as seen in Fig. 2. From this data the electron

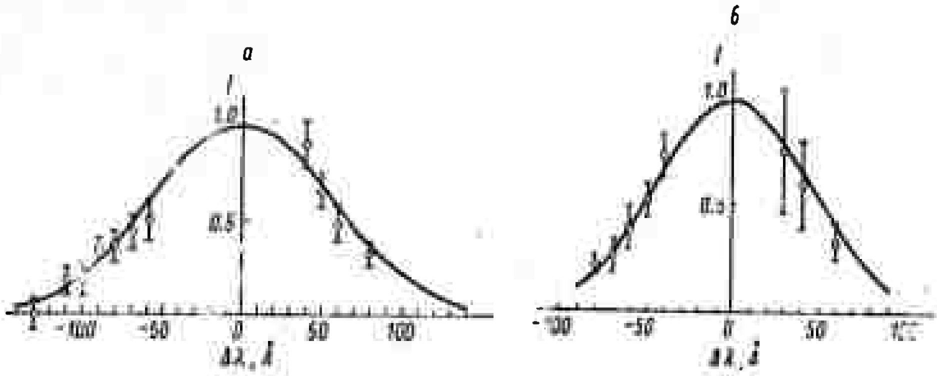


Fig. 2. Laser scatter spectra
a- 4.5 ka; b- 9 ka.

temperature and density at the center of the discharge was calculated to be 10.5 ev and $3.3 \times 10^{13}/cm^3$ for the 4.5 ka discharge, while for the 9 ka pulse the figures were 6.2 ev and $4.4 \times 10^{13}/cm^3$. The lower temperature in the latter case is attributed to increased losses, and to the fact that in these cases the measurements were taken near the end of the 1.6 μs current pulse. The data also show that the electron parameters at the center of the discharge column did not differ appreciably from the mean values taken over a plasma cross-section.

Burakov, V. S., P. A. Naumenkov, and G. A. Kolosovskiy. Using a tunable laser to determine absorption characteristics of a plasma. ZhPS, v. 16, no. 1, 1972, 54-57.

Tunable dye lasers using several active solutions were used for plasma diagnosis. Dye pumping was by neodymium, ruby, or xenon flashlamp; Fig. 1 shows the configuration for pumping with ruby second harmonic. By introducing dispersion elements into

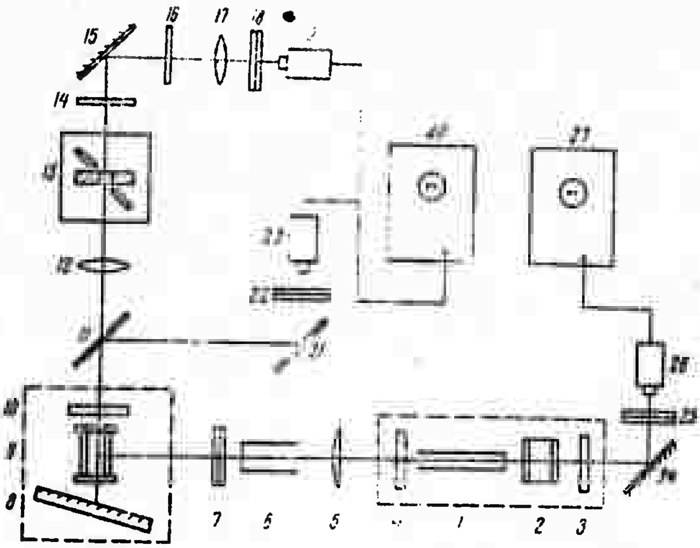


Fig. 1. Dye laser plasma probe
1-4 - ruby pump; 5- lens; 6- KDP doubler; 7, 8- diffraction grids; 9- active solution; 10- output mirror; 11, 14- semi-transparent glass; 12, 17- lenses; 13- plasma in capillary; 19, 23, 26- phototubes; 15, 21, 24- rotatable mirrors; 16, 22, 25- neutral filters; 18- interference filter; 20, 27-oscilloscopes.

the solution it was possible to vary generation over a range of 20-30 nm. The probe beam was focused to 1.5 mm diameter on a plasma formed by a high-current discharge through a 3 mm dia. textolite capillary. The 400 μs current pulse was rectangular at 7.5 ka; plasma temperature reached 40,000°K. The transmitted spectral response was recorded as indicated in the figure, for four different dye solutions whose parameters are given in Table I. A sample spectrogram is included, but the bulk of the article deals with the technique rather than its results.

(See Table on next page)

Active element	1	2	3	4	5
Rhodamine 6G	603-575	599	4.5	589	7.0
		588	4.4	589	7.0
		578	4.0	573	7.5
Uranyl	570-545	558	2.8	558	6.0
1, 1, 4, 4-tetraphenyl-butadiene in cyclo-hexane	550-480	517	2.7	513	8.0
7-diethylamino-3, 4-dimethylcoumarin	490-457	468	2.3	473	9.0

Table I. Dye laser probe parameters.

1- lasing range, nm; 2- selected wavelengths, nm; 3- plasma absorption coefficient, cm^{-1}; 4- transmission peak of filter, nm; 5- filter bandpass, nm.

Baksik, Augustyn. Organic dye laser. PF, no. 2, 1972, 201-204.

In June 1971, the collective of the Department of Nonlinear Optics, Institute of Chemical Physics (IPPCh), University of Warsaw, put into operation its own organic dye laser. The active medium is rhodamine-6G dissolved in ethyl alcohol. The liquid is pumped by xenon flashlamp with a lasing threshold of 40 joules. The laser generates 100 w beams of yellow light of 13μs duration. Figure 1 presents the diagram of the laser unit. The active solution occupies the 96x3.5 mm cylinder of

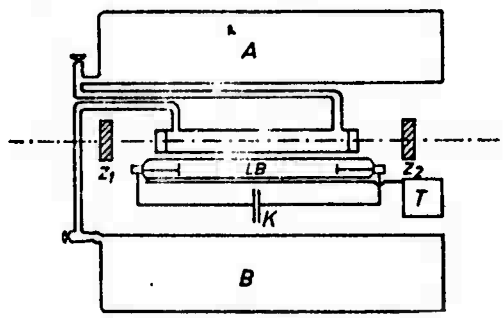


Fig. 1. Laser schematic
A, B- liquid reservoirs; LB- flashlamp;
Z_1, Z_2- mirrors; K- capacitor; T- trigger.

a quartz cell, which is connected to the two reservoirs. Two flat mirrors with zero and 2.6% transmissibility are placed parallel to the cell to complete the optical resonance chamber. The flashlamp is fed from a battery of 40μf capacitors. A photograph of the laser unit is shown in Figure 2. With a pumping energy of 45 joules the same rhodamine solution can be energized once a minute; however, each consecutive emission is weaker than the preceding one due to overheating of the liquid. The liquid can be re-used.

(Fig. 2 on following page)

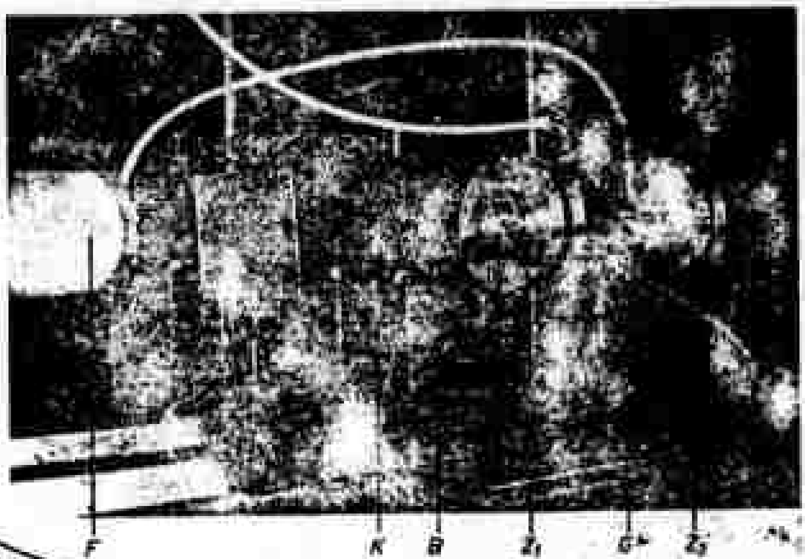


Fig. 2. Laser model

F- photo multiplier; K- capacitor; B- liquid reservoir; Z_1, Z_2- mirror holders; G- laser head.

Shigorin, V. D., and G. P. Shipulo. Nature of optical nonlinearities of organic molecules. KSpF, no. 10, 1971, 34-40.

Measurements were made of the efficiency $I^{2\omega}$ of second harmonic generation (SHG) from interaction of a Nd glass laser with crystals of 15 o-, m-, and p-disubstituted XC_6H_4Y benzenes, where $X = NO_2$, NH_2, OH, or CH_3CO and $Y = NH_2$, $N(CH_3)_2$, CHO, OH, Br, Cl, CH_3, or OCH_3. The experimental $I^{2\omega}$ values were correlated with the structural parameter δ of the cited crystals, which was calculated from

$$\delta \sim (I^{2\omega}\Delta)^{1/2}(n-1)^{-3}. \qquad (1)$$

where $\Delta = n_2 - n_x$ is birefringence and n is the refractive index of the biaxial crystals. The average Δ and n values were determined in powdered

crystals with average grain size ~100μ. $I^{2\omega}$ was measured with a ~20% accuracy using a nonfocused laser beam at $\lambda = 1.06\mu$ and P~20mw/cm^2. The tabulated $I^{2\omega}$, n, Δ, and δ data for some of the studied crystals show that $I^{2\omega}$ increases significantly by introducing the electron acceptors, e.g., NO_2, CHO, $COCH_3$, in the C_6H_6 molecule, and even more so by introducing conjugated donor-acceptor groups. In the latter case, refractometric data confirmed an increase in δ, predicted on the basis of increased polarity of such molecules. The cited $I^{2\omega}$ data and the δ data calculated from (1) for some other organic compounds made it possible to attribute optical nonlinearity of organic compounds primarily to electrical asymmetry of molecular bonds. It follows that organic crystals with centro-asymmetrical coordination or covalent bonds, e.g., C≡N, C=O, C=N, O-H, N-H, C-F, a high effective charge and high dipole moment, are expected to be optically nonlinear. Also, a significant nonlinearity is expected in compounds containing polar groups of increased electron density, e.g., NO_2, CHO, $COCH_3$, and other electron acceptors. An important redistribution of electron density in the ground state is required for optical nonlinearity.

Dyadyusha, G. G., O. V. Przhonskaya, Ye. A. Tikhonov, and M. T. Shpak. Strong fluorescence from the second excited state of organic dye molecules in solution. ZhETF P, v. 14, no. 5, 1971, 330-333.

A strong short-wave optical emission was observed from alcohol solutions of type II, III, and V-VIII cyanine dyes as defined in the table below. Excitation was by the second harmonic of a ruby laser at 5Mw power or a mercury lamp (λ = 313, 366, and 405 nm.) In addition to the short-wave band, the fluorescence spectra of the II, VI, VII, and VIII dye solutions at 300°K exhibited the usual long-wave fluorescence band from the $S_1 \rightarrow S_0$ transition. Interpretation of the observed

short-wave emission as fluorescence from the $S_2 \rightarrow S_0$ electron transition was confirmed by a series of additional experiments. The experiments excluded the possibility of short-wave emission caused by photochemical decomposition of the dyes, or by the presence of impurities. Thus a

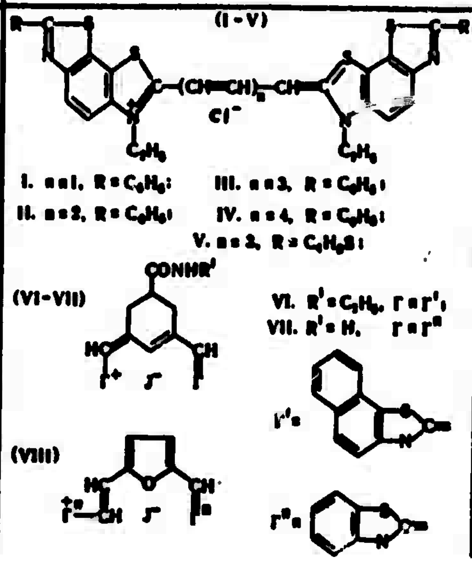
No.	Structural formula	Max. absorption, nm S_1	Max. absorption, nm S_2	[illegible]	Max. fluorescence, nm S_1	Max. fluorescence, nm S_2
I		600	360	[illegible]	630	–
II		696	380	315	720	490
III		800	365	415	840	500
IV		900	400	500	970	–
V		840	410	400	840	500
VI		680	360	330	710	470
VII		660	330	320	878	470
VIII		730	360	370	745	440

Table I. Table of dyes

linear dependence of the short-wave fluorescence intensity of dye II on intensity of pumping by a single pulse at ~50 Mw power excluded impurity fluorescence. Differences in fluorescence spectra of the I-VIII dyes were explained by different lengths of polymethine chains, different structure of end-groups, and the presence of different rings in the chain. It is concluded that the cited dyes may be used for generation from the $S_2 \rightarrow S_0$ transition.

Bakhshiyev, N. G. Intermolecular interaction and stimulated emission spectra of liquid activated systems. I. Effect of relaxation and fluctuation processes on the mutual positioning of electron states of the activator molecule in a solution. OiS, v. 32, no. 6, 1972, 1151-1158.

In the framework of a systematic analysis of the intermolecular interaction effect on stimulated emission spectra of liquids, the author describes the total energy (or potential) $W_{i(univ)}$ of universal (van der Waals) interactions of a molecule with the solvation sheath and reactive field R_i of the sheath as the algebraic sum of respective enthalpic and entropic components. The formulas for $W_{i(univ)}$ and R_i were established for three possible relaxational situations: $t_i \geq \tau_R$ (total intermolecular relaxation and thermodynamic equilibrium), $t_i \approx \tau_R$ (partial relaxation and limiting nonequilibrium state), and $t_i \leq \tau_R$ (absence of relaxation and limiting nonequilibrium state), where t_i is the lifetime of a molecule in i state and τ_R is the relaxation time constant. Similarly, in the last two nonequilibrium situations, the universal Franck-Condon potentials W_j^{FC} (univ) and reactive fields R_j^{FC} (or.-ind.) were formulated. Also, $W_{i(univ)}$ and $R_{i(or.-ind.)}$ were formulated with allowance for their fluctuations. On the basis of the established formulas, diagrams of electron energy levels of the activator molecule in solution, with and without allowance for fluctuation processes, describe light absorption and emission by a free or dissolved molecule. Analysis of the diagrams and the corresponding emission spectra showed that, in the cases of $t_e \geq \tau_R$ and $t_e \sim \tau_R$, the Franck-Condon ground state which is terminal for a lasing transition is at a higher energy level that the E_g^{eq}. Hence, orientational and translational relaxation actively contributes to stimulated emission from a liquid system. Fluctuation processes in the liquid phase are the cause of spectral inhomogeneity of a stimulated emission, since at $t_e \geq \tau_R$ the equilibrium distribution of activator molecules by their interaction potentials is different in the ground and excited states.

Aristov, A. V., M. Yu. Vorob'yev, D. A. Kozlovskiy, and V. M. Podgayetskiy. Dye lasers with helical lamp pumping. PTE, no. 2, 1972, 169-170.

A lamp for pumping dye lasers at increased threshold energy W_{th} has been developed from the mass produced IFK-15000 lamp. The increase in W_{th} from 1,500 j at a 10μsec electrical pulse width in a standard helical lamp to over 2,100 j at a 6μsec pulse width was achieved by decreasing initial Xe pressure p_0 from 300 to 100 torr and substituting a double helix for a single helix configuration. The nominal parameters of the discharge circuit are: 5μf capacitance, 0.4μh inductance, and 0.04 ohm resistance. Experiments are described with rhodamine 6G and unsubstituted rhodamine liquid lasers pumped by the improved flash lamp, using a resonator cavity 60 cm. long, formed by plane dielectric mirrors with 99 and 50% reflection. The emission efficiency and pump energy η% absorbed at λ = 180-390 and 470-565 nm were only weakly effected by a decrease in p_0. The service life of the lamp exceeded 10^3 flashes at ~1.5kj flash energy. Measurements show that η% absorbed at λ = 180-390 nm increases continuously with increase in discharge energy W, and η% absorbed at λ = 470-565 nm exhibits an uncharacteristic maximum at W = 0.7 kj. The pumping pulse width τ_c at λ = 540 nm decreases with the increase in W. At W ≅ 1.5 kj, τ_c ≅ 6μsec and the average flash power reaches 0.25 Gw. The rhodamine 6G laser emission efficiency is twice that of the unsubstituted rhodamine laser. At relatively short laser pulses of 6--7μsec, an emission radiance of over 10^8 w/cm^2/ster, i.e. about an order of magnitude higher than with tubular lamps, was obtained at ~1 j emission energy and <2 mrad. beam divergence. Fig. 1 shows a cross section of the lamp.

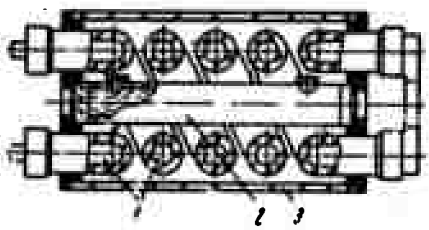


Fig. 1. Laser head
1- flashlamp; 2- dye vessel;
3- reflector.

Danilov, V. V., and Yu. T. Mazurenko. Spectral-selective optical quenching of luminescence in complex molecules. IAN Fiz, no. 5, 1972, 1122-1124.

In agreement with the Franck-Condon principle and earlier experimental data, spectral selectivity of luminescence quenching by laser radiation was confirmed experimentally. The two-photon luminescence was excited by a Q-switched ruby laser in a glycerinic solution of rhodamine B and an aqueous solution of sodium fluorescein. Laser pulse width was 15 nsec and output power ~50 Mw. Power density of the focused beam was 500 Mw/cm^2. The recorded spectra of two-photon luminescence were distorted in comparison to the luminescence spectra recorded with excitation by a mercury lamp. Also, the laser-excited spectrum of rhodamine B in glycerine was significantly more distorted than the corresponding spectrum of fluorescein. The laser-excited luminescence spectrum of rhodamine 6G in aqueous solution was even more distorted than the corresponding spectrum of rhodamine B solution. The cited experimental findings are in agreement with the calculated rates

W_q and W_v of luminescence quenching and vibrational relaxation of the singlet excited state, respectively. Thus, $W_q \approx W_v$ for rhodamine B and $W_q \approx 0.1\ W_v$ for fluorescein. A new method for investigation of powerful radiation interaction with complex molecules may be developed on the basis of the data obtained. This method may be useful in research of complex organic molecules for optical shutters and active lasing media.

In an additional experiment, spectral distortion was found unchanged, when the concentration of rhodamine 6G in isopropyl alcohol solution was varied from 4×10^{-4} to 6×10^{-6}. This finding eliminated the possibility of single-photon excitation of the triplet state as the mechanism of laser-excited luminescence.

Smol'skaya, T. I., and A. N. Rubinov. <u>Effect of transverse distribution of pumping on the power and profile of thermooptical distortions in a rhodamine 6G liquid laser</u>. ZhPS, v. 16, no. 4, 1972, 618-626.

To select optimum cell dimensions and dye concentration for a liquid dye laser, transverse (cross-sectional) distribution of pumping efficiency was calculated for a cylindrical cell with a rhodamine 6G alcohol solution, illuminated by diffuse radiation of a wide spectral composition ($\nu = 10^4 - 5 \times 10^4 cm^{-1}$). Allowance was made for absorption and excitation spectra. Temperatures of the pump sources were assumed to be 17,000 or 22,000°K, i.e. equivalent to that of a Xe flash lamp, or pinch and similar high-temperature sources, respectively. At both source temperatures, the radial pumping efficiency $B_{13}U$ reaches its maximum value near the relative coordinate $\sigma \sim 0.6$, when either dye concentration or cell radius r_0 is doubled, i.e. the $k_x^{max} r_0$ value is increased from ~2 to 4.75 (k^{max} is the absorption coefficient of rhodamine 6G in the $1.875 \times 10^4 cm^{-1}$ band). At $k^{max} \times r_0 = 4.75$, the most

intensely pumped volume of the dye solution is the ring-shaped zone about midway between the cell center and its wall. This zone shrinks to a narrow ring near the wall at $k^{max} \times r_0 = 9.5$ and 19. Excitation probability near the center is decreased slightly if the UV portion of the excitation spectrum is filtered off partially, or by a 3-4 factor if totally filtered. In the latter case, the most uniform radial distribution of $B_{13}U$ is achieved at $k^{max} \times r_0 = 9.5$.

Using the cited calculated data, the dependence of the laser power and efficiency on r_0 and active substance concentration was analyzed and the profile of thermal distortion of the dye solution was determined. The analytical data are plotted in Fig. 1. Fig. 1a shows that

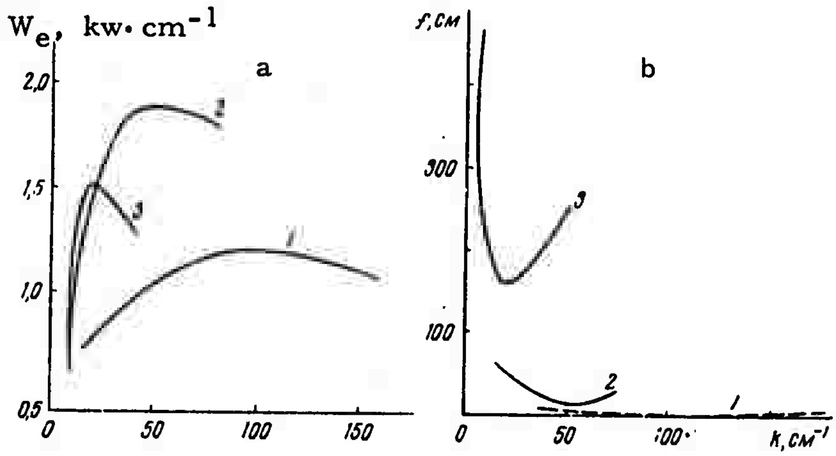


Fig. 1. Emission power (a) and focal distance of the lens, characterizing thermal distortions in the cell center (b), versus dye concentration. r_0 = 0.125 (1), 0.25 (2), and 0.5 (3) cm.

W_e^{max} is observed at the same value of $k^{max} \times r_0 \sim 10$, in agreement with the experimental $(k^{max} \times r_0)_{opt} \cong 9$ for a cell 10 cm long and ϕ = 0.7 cm and with the 9.5 value calculated for the case of a highly nonuniform $B_{13}U$ distribution. The optimum r_0 increases with increase in pump intensity. Calculated r_0 dependence of laser efficiency differs from that of W_e; hence, the conditions for W_e^{max} do not match

those of the maximum laser efficiency. Fig. 1b shows optical distortion profile in the cell central zone. The minimum f of the equivalent lens corresponds to $k^{max} \times r_0 \sim 9.5$. At $k^{max} \times r_0 = \epsilon = \text{const}$, the optimum dye concentration is given by

$$n = \frac{\varepsilon}{\sigma_{13}^{max} r_0} \tag{1}$$

where σ_{13}^{max} is the cross section of maximum absorption of the dye. Calculations show that f is proportional to r_0^3 and inversely proportional to the cell length, pump energy, and a parameter ξ, which is the characteristic of solvent sensitivity to thermal distortions. Selection of a solvent with minimum $|\xi|$, e.g. water, would minimize thermal inhomogeneity. Minimum losses due to nonuniform heating are achieved in water at 4°C. Calculations show that $|dn/dt|$ derivative and $|\xi|$ are smaller than the respective values for Nd glass in the 3.5-4.5°C and 3-5°C ranges. At pump energy = 0.1 j/cm², solution temperature increases by 0.2-0.3°C. At initial t = 2.5-3.0°C, $|\xi|$ of a solution is smaller than that of Nd glass even at pump power and duration an order of magnitude higher. The use of heavy water solvent shifts the working temperature range to even higher values. It is shown that a short-duration pumping significantly decreases the effect of nonuniform heat distribution on the optical homogeneity of a solution, and eliminates the undesirable effect of acoustic distortions in the cavity.

Lazareva, L. D., and V. A. Martsinovskiy. Thermocontrolled light filter. ZhPS, v. 16, no. 5, 1972, 925-927.

A brief discription is given of a thermally controlled optical filter in which the passband can be linearly shifted with temperature over a certain range. The basic filter was a narrowband interference

type formed by vacuum deposition of ZnS followed by MgF_2. The heating layers were of fluorine-doped $SnCl_2$, obtained by pyrolysis at 420-450°C, having a 80-100 ohm resistance and 90% transmissibility. A quartz base 2 mm thick was used. Two variants of filter-heater assembly are shown in Fig. 1 and the temperature characteristic of the filter

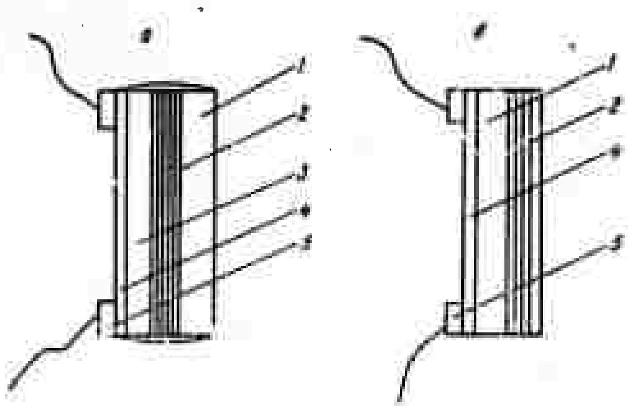


Fig. 1. Thermocontrolled filters
1, 3- substrate; 2- filter section; 4- heating layer; 5- silvered contacts.

is given in Fig. 2. Following the 4th heat/cool cycle of 0°-240°C the

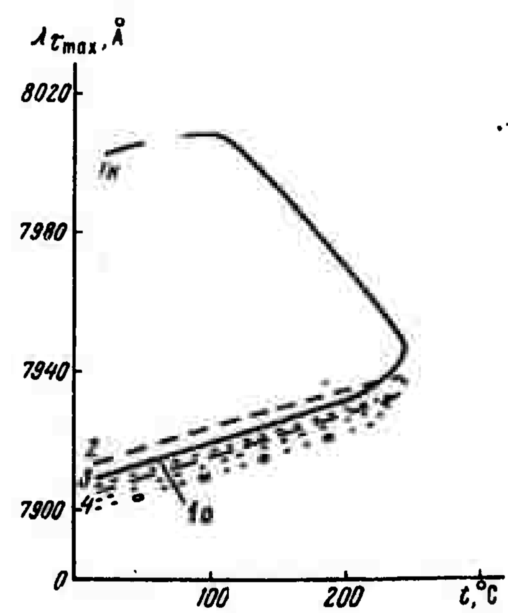


Fig. 2. Temperature characteristic of thermofilter. Numbers refer to heating/cooling cycles.

the response stabilized as shown in Fig. 2, and was repeatable over 14 subsequent cycles. With higher temperature materials the range could in theory be extended, however at the cost of lower peak response and a broadening of the passband. A photo of the filter is included.

Rats, B., I. Kechkemeti, and L. Kozma. Generation in mixed solutions of organic dyes. ZhPS, v. 16, no. 5, 1972, 914-915.

Relative output energy E and emission wavelength λ_e were measured in a liquid dye laser with rhodamine B-rhodamine 6G mixed solutions as the active media. Mixed dye solutions were used in expectation of gain on account of excitation energy transfer from the rhodamine 6G donor to rhodamine B acceptor. The dyes were selected on the theory of overlapping of the rhodamine B absorption spectrum with the rhodamine 6G fluorescence spectrum. A water-cooled cylindrical cell with dye solution, 80 mm long and 4 mm diam., and type IFP-800 flash lamps were contained in an elliptical reflector. The pumping pulse length was 2 μsec; the rhodamine B concentration was kept constant (10^{-4} mol/l). Rhodamine 6G solutions of increasing concentrations were added to rhodamine B in ethanol with 6% acetic acid additive. E of the laser increased from 1.00 to 1.97, when rhodamine 6G donor concentration was increased from 0 to 10^{-4}mol/ℓ, then E decreased to 0.42 with a further increase in rhodamine 6G concentration to 10^{-3}mol/ℓ. Concurrently, λ_e shifted from 625.9 to 620 nm. The observed gain and spectral shift clearly resulted from a partial transfer of the absorbed pump energy from donor to acceptor. The observed loss at higher donor concentrations is explained by concentration quenching and associated optical inhomogeneity of the medium.

Rubinov, A. N., T. I. Smol'skaya, and S. S. Anufrik. Effect of thermooptical distortions on the amount of losses and the space-angular characteristics of flashlamp-pumped rhodamine 6G laser radiation. ZhPS, v. 16, no. 5, 1972, 802-809.

The effects of thermooptical distortions in a dye laser cavity were evaluated on the basis of experimental data. The oscilloscope traces of pumping and emission from a 10^{-4} mol/ℓ alcohol solution of rhodamine 6G in a 100 mm long, 5 mm dia. cell revealed a substantial increase of integral energy loss Δk^{int} over the period of generation. The Δk^{int} fraction attributable to thermooptical distortions was evaluated as the difference between $\Delta k^{int} = 0.15 cm^{-1}$ and Δk^{int} fractions due to photodecomposition of dye molecule and triplet-triplet absorption. The loss factor k_{therm} of thermooptical distortions was found to be $0.060 cm^{-1}$ in agreement with the $0.065 cm^{-2}$ value determined earlier from the time sweep of angular divergence and emission field at the cell base. The experimentally determined value of output energy at a resonator base L = 60cm. was about half that at L = 25cm. This fact indicated also a significant contribution of thermal distortions to Δk^{int}.

In another series of experiments, the field patterns of emission from the cell base were recorded at the mirrors (near field) and in the focal plane of a lens with f = 1m (far field), at rhodamine 6G concentrations corresponding to $k^{max} \approx 6 - 57 cm^{-1}$. In the near field, the most uniform distribution of emission across the base and the minimum (~10') beam angular divergence were observed at $k^{max} = 6 cm^{-1}$. In contrast to the radial pumping energy distribution calculated earlier by two of the authors [ZhPS, v. 16, 1972, 618], laser emission intensity at $k^{max} > 6 cm^{-1}$ was significantly weaker in the ring zone between the central bright spot and the peripheral ring. This discrepancy was explained

by the optical inhomogeneity of the solution in connection with radially nonuniform heating. Generation efficiency is higher in the central zone of the cell because of more uniform distribution of refractive index of the solution. In the far field, at $k^{max} > 10cm^{-1}$, the central spot corresponds to a beam divergence of about 4'. Experiments with shielded center or shielded peripheral ring zones of the cell base showed that radiation from the center is due to the least distorted cell zone. The output energy of the laser is maximum with concentrations which correspond to a sharply nonuniform pumping distribution and to a significantly inhomogeneous near- and far-field structure. Laser emission from a strongly optically inhomogeneous solution is filamentary, analogous to that from an inhomogeneous ruby crystal. The experimental fact that a satisfactory optical homogeneity of a solution is attained some 20 minutes after the cell is filled signifies that density fluctuations are the real cause of optical inhomogeneity; optical homogeneity in fact cannot be obtained under conditions of rapid temperature fluctuations. The experimental oscilloscope traces of emission, recorded under these conditions, show that for the case of solution temperature lower than wall temperature, deterioration of power characteristics is greater than in the inverse case.

Kovalev, A. A., V. A. Pilipovich, and Yu. V. Razvin. Some features of polarization of stimulated emission from organic dyes. ZhPS, v. 16, no. 4, 1972, 654-657.

A detailed study is presented of the experimental data on polarization of stimulated emission from cryptocyanine and chloroaluminum phthalocyanine solutions under different excitation conditions. Polarization degree P was evaluated as a function of the angle ξ between the electric vector of the excitation beam and the normal to the resonator axis. At $\xi = 0^o$ (orthogonal excitation), P of stimulated emission from cryptocyanine solutions in glycerin or alcohol was approximately 1 over

the available range of pump energies. Only a small depolarization ($P = 90$-95%) was observed with phtalocyanine solutions at a high pump energy. At ξ varied from 0 to 90°, P depends on the ratio of initial gain factor k_g to the loss factor k_{ℓ} of the resonator. At increasing k_g, i.e. increased excitation energy of a single pulse, P decreases, with the decrease most pronounced in the range of low pump energies. The same pattern of P variations was observed when k_{ℓ} was decreased by varying transmissibility of the mirrors, while maintaining pump energy constant. The widest range of P was observed at high k_{ℓ}.

The effect of dye concentration on P was studied in chloro-aluminum phtalocyanine alcohol solutions pumped by a ruby laser with 4 j. energy and single-pulse length of 20-30 nsec. As expected, the peak emission power and the minimum P were obtained at an optimum concentration $= 1.2 \times 10^{17} cm^{-3}$. P increases to ~ 1 at small or sufficiently high ($\sim 2.5 \times 10^{7} cm^{-3}$) concentrations. Thus, the cited data confirmed an earlier conclusion that P depends on the direction of polarization vector of excitation beam, as well as on the k_g/k_{ℓ} ratio. P is also strongly dependent on the amount of loss in the resonator. The fact that P in the alcohol solutions is higher than P in glycerin solutions is explained by a higher generation threshold, hence lower generation power and conversion factor, in alcohol solutions.

B. Recent Selections

i. Beam-Target Effects

Barmin, A. A., and A. G. Kulikovskiy. Boundary conditions at the surface of a discontinuity occurring from the interaction of powerful radiation with metal. IN: Sbornik. Nauchnaya konferentsiya Institut mekhaniki Moskovskogo universiteta, Moskva, 22-24 May 1972, 1972, 7. (RZhMekh, 9/72, no. 9B920)

Boyko, Yu. I., and A. K. Yemets. Study of laser self-focusing in alkali-halide single crystals, according to data on shift of the damage center. DAN SSSR, v. 206, no. 2, 1972, 319-322.

Golubets, V. M., M. I. Moysa, Yu. I. Babey, and G. V. Plyatsko. Effect of laser processing on part wear in an abrasive-oily medium. FKhMM, no. 4, 1972, 114-115.

Konakov, Yu. P. Beam-conductive heat transfer in optically dense media. I-FZh, v. 23, no. 3, 1972, 459-464.

Orlov, A. A., and P. I. Ulyakov. Development of internal destruction in silicate glasses and polymers from laser radiation. ZhPMTF, no. 4, 1972, 138-145.

Petrov, A. A., N. A. Pobedonostseva, and G. V. Skvortsova. Feasibility of using a laser flare as a light source in a spectrally-isotopic method. ZhPS, v. 17, no. 3, 1972, 391-393.

Velichko, O. A., V. P. Garashchuk, and V. E. Moravskiy. Characteristics of pulsed laser welding of open lap-joints. Avtomaticheskaya svarka, no. 4, 1972, 75-76. (LZhS, 34/72, no. 113804)

Velichko, O. A., V. P. Garashchuk, and V. E. Moravskiy. Laser welding of butt joints of various metals. Avtomaticheskaya svarka, no. 3, 1972, 71-73. (LZhS, 30/72, no. 99945)

Vitovskiy, N. A., G. A. Vikhliy, V. V. Galavanov, and T. V. Mashovets. Formation of defects in indium antimonide from light effects. IN: Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 2, 1971, 22-26. (LZhS, 32/72, no. 105160)

Volosevich, P. P., and Ye. I. Levanov. On self-similar motions of a two-temperature plasma. IN: Sbornik. Teplo- i massoperenos, v. 8, Minsk, 1972, 29-35. (RZhMekh, 9/72, no. 9B119)

Zuyev, V. Ye., A. V. Kuzikovskiy, V. A. Pogodayev, S. S. Khmelevtsov, and L. K. Chistyakova. Thermal effect of optical emission on small water drops. DAN SSSR, v. 205, no. 5, 1972, 1069-1072.

Zverev, G. M., Ye. A. Levchuk, V. A. Pashkov, and Yu. D. Poryadin. Surface damage in lithium niobate and tantalate from laser radiation. Kvantovaya elektronika, no. 8, 1972, 94-96.

ii. Beam-Plasma Interaction

Aleksandrov, A. F., V. V. Zosimov, and I. B. Timofeyev. Power instability of a linear self-compressed discharge in a dense optically nontransparent plasma. KSpF, no. 2, 1972, 25-30. (LZhS, 32/72, no. 105110)

Arifov, T. U., and I. M. Rayevskiy. Laser plasma charging of magnetic traps. ZhTF, no. 8, 1972, 1764-1766.

Batanov, G. M., and K. A. Sarksyan. Nonlinear amplification of a weak plasma electromagnetic wave near the second harmonic of a powerful pumping wave. KSpF, no. 2, 1972, 14-18. (LZhS, 32/72, no. 105128)

Kaliski, S. Averaged equations of laser heating of plasma in a focus-type system, taking the heat of nuclear fusion into account. Bulletin De L'Academie Polonaise Des Sciences, v. 20, no. 6, 1972, 123(457)-131(465).

Kaliski, S. Averaged equations of laser heating of two-temperature plasma in a focus-type system, taking the heat of nuclear fusion into account. Bulletin De L'Academie Polonaise Des Sciences, v. 20, no. 6, 1972, 133(467)-138(472).

Petrov, O. Combustion of a light beam. Sovetskaya Latviya, 8/30/72, p2.

Popov, S. P. Stationary regime of the radially-symmetrical motion of laser heated vapors, taking temperature and ionization nonuniformit into account. ZhPMTF, no. 4, 1972, 3-7.

Vinogradov, A. V., and V. V. Pustovalov. Plasma heating during stimulated laser radiation scattering. Kvantovaya elektronika, no. 8, 1972, 3-22.

Zaritskiy, A. R., S. D. Zakharov, P. G. Kryukov, and A. I. Fedosimov. Measurement of polarization of back scatter radiation during laser plasma heating. Kvantovaya elektronika, no. 8, 1972, 89-90.

Zigel', R., S. Vitkovski, Kh. Baumkhakker, K. Byukhl', K. Aydman, Kh. Khora, Kh. Menike, P. Mulser, D. Pfirsh, and Kh. Zal'tsman. Review of laser plasma research carried out at Max Planck Institute of Plasma Physics in Garching. Kvantovaya elektronika, no. 8, 1972, 37-44.

2. Effects of Strong Explosions

A. Abstracts

Adadurov, G. A., O. N. Breusov, A. N. Dremin, V. N. Dobryshev, and A. I. Rogacheva. Effect of dynamic pressure on subgroup IV oxides. FGiV, no. 2, 1971, 272-275.

A study is made of irreversible structural changes of titanium, zirconium, and hafnium oxides after they have been acted upon by shock waves of various amplitudes. These oxides are characterized by polymorphism, both under normal conditions and at high pressures. The initial materials were titanium oxide (pure for anatase and very pure for rutile), and high-purity zirconium oxide and hafnium oxide, all single-phase in the initial state. Shock compression was effected principally by using various explosives in confined cylindrical ampoules. Tests were conducted on specimens of varying porosity; shock adiabats were unknown, and therefore the parameters of shock compression could not be evaluated. The properties of the confined specimens were studied on various segments, designated as zones I, II, and III, as listed in Table I. The results of an x-ray investigation of titanium oxide, after it has been subjected to shock wave loads generated by explosives of varying strength, are presented in the table. As a result of shock compression, anatase was converted into rutile. The completeness of this transition depended upon the shock-wave amplitude, and increased with the use of a stronger explosive. In most cases, formation of the TiO_2-II high-pressure phase was observed; the maximal degree of this transition was noted after the repeated action of a charge with a detonation velocity D = 6.90 km/sec (zone III). From the initial value of 3.840 ± 0.004 g/cm^3 for anatase, the pychometric density of titanium oxide specimens increased correspondingly with repeated compression. For samples from zone I it comprised 3.85 g/cm^3, from zone II- 3.90 g/cm^3, and from zone III- 4.045 ± 0.004 g/cm^3. One-time action

a D, км/сек	g Зона	h Анатаз*	i Рутил	TiO_2 - II
b 4,80 (ампула вакуумирована)	I	+	—	—
	II	+	—	—
	III	+	—	—
c 6,90 и 4,80 (последовательное сжатие)	I	+	?	+
	II	+	—	+
	III		+	+
d 6,90 (железный вкладыш)	I	+	—	+
	II	+	+	+
	III	+	+	+
e 6,90 (медный вкладыш)	I	+	+	+
	II	—	+	+
	III	—	+	+
f 6,90 (двукратное сжатие)	I	+	—	+
	II	+	+	+
	III	+	+	+
7,90	I	—	+	—
	II	—	+	—
	III	—	+	—

j * Знаки «+» и «—» обозначают наличие или отсутствие соответствующей модификации.

Table I.

Key to Table I: a- detonation rate D, km/sec; b- evacuated ampoule; c- successive compression; d- iron specimen; e- copper specimen; f- twofold compression; g- zone; h- anatase*; i- rutile; j- * signs "+" and "-" signify the presence or absence of the corresponding modification.

by the charges shown in Table I caused no essential structural changes in zirconium oxide and hafnium oxide. Taking into account the possibility of annealing of the high-pressure phases, experiments were conducted under conditions facilitating a decrease of the residual temperatures. With this aim, anatase was subjected to shock compression (D = 4.80 km/sec) after prior evacuation of air from the ampoule. Conversion of anatase into rutile was not observed, nor was any high-pressure phase observed. These results testify to the perceptible influence of the air remaining in the pores of the investigated substance upon the value of the residual temperature. Shock compression of zirconium oxide and hafnium oxide by a plane shock wave (p = 80 kbar) also produced no essential structural changes,

even when ampoules with the specimens were precooled to the temperature of liquid nitrogen.

With the action of dynamic pressure upon titanium, zirconium and hafnium oxides, all three basic factors of dynamic compression are thus manifested: large pressure gradients, high dynamic pressures, and high residual temperatures. Large pressure gradients at comparatively low shock-wave amplitudes bring about an essential increase in defects in the oxides' crystalline lattice, shown by a decrease of the pychometric density and an increase in the diffuse nature of the diffraction lines. High residual temperature caused the conversion of anatase into rutile, and at high shock-wave amplitudes caused annealing of the high-pressure phase and of defects created by the shock wave front.

Adadurov, G. A., V. V. Gustov, and P. A. Yampol'skiy. Device for confinement of materials subjected to shock compression at varying pressures. FGiV, no. 2, 1971, 284-289.

A procedure is presented by means of which it is possible, in a single experiment, to achieve the shock compression of one or several different materials with a wide interval of fixed pressures, with succeeding confinement of the specimens for conducting physicochemical analyses. This procedure involves the use of the device shown in Fig. 1. The shock wave in the assembly is created by the shock of an aluminum plate, 1 mm thick, scattered by the explosion products from the plane detonation of a thin layer of explosive. The flight distance was 25 mm. Also presented in Fig. 1 are the parameters of shock compression in copper at varying depths. The characteristics of acrylamide and rubber specimens subjected to shock compression in the cited multilayer assembly differ somewhat from the characteristics of these objects, obtained in confinement ampoules

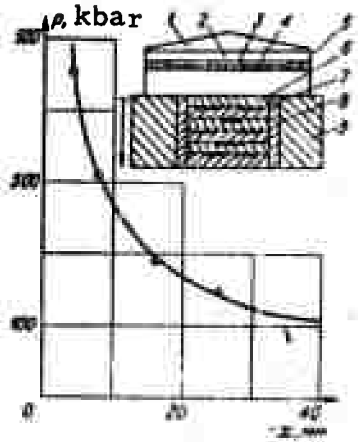


Fig. 1. Relationship of pressure to thickness of copper, and the experimental device.
1- generator of plane detonation wave; 2- TNT charge $\rho_0 = 1.2\ g/cm^3$, diameter 100 mm; 3- air gap; 4- aluminum firing pin 1 mm thick, diameter 70 mm; 5- steel disk; 6- copper plates with depressions under the specimens; 7- specimens of the investigated material; 8- steel cylinder; 9- steel ring.

of the conventional type. These differences consist in the fact that the observed chemical effects are shifted into a region of higher pressures. These results show that a multilayer assembly considerably simplifies the conduct of explosion experiments, and expands the possibilities of research on physicochemical conversions in materials.

Vinokurov, A. Ya., Ye. M. Kudryavtsev, V. D. Mironov, and Ye. S. Trekhov. Thermal decomposition of nitrogen oxide. KSpF, no. 12, 1971, 8-15.

An experimental analysis of the thermal decomposition of NO was performed in a shock tunnel behind incident and reflected shock waves in the temperature range 2000-6000°K. Pure NO and NO mixed with argon

were used. The NO concentration was determined from the absorption in the (0.2) band of the NO γ-system at $\lambda = 2456 Å$, with allowance for additional absorption by oxygen molecules generated during thermal decomposition of NO. From the measured concentrations of O and the NO mixture, atomic oxygen accumulation was determined. Measurements of NO_2 radiation intensity as a function of time were made in the spectral range 5150 to 5820 Å. Data for the concentrations of NO and the NO-O mixtures obtained from oscillograms are shown graphically in Figure 1. The concentration - time plot is divided into three regions, for which chemical reactions and the rate of concentration change are discussed. In region I, for $T < 3000°K$,

$$NO + NO \longrightarrow N_2O + O \tag{1}$$

is predominant. For $R > 3000°K$, in addition to (1), a dissociation reaction takes place:

$$NO + M \longrightarrow N + O + M \tag{2}$$

Time dependence of O and NO concentrations for this region are determined by:

$$(NO) = (NO)_0 \left\{ 1 - K_{eff} (NO)_0 \, t \right\} \tag{3}$$

and

$$(O) = (K_{eff} - K_1)(NO)_0^2 \, t \tag{4}$$

where K_{eff} = the NO decomposition rate constant. The rate of thermal decomposition change of NO is attributed to the progressive acceleration of the chain reaction due to the increased concentration of oxygen atoms :

$$NO + O \longrightarrow N + O_2 \; ; \tag{5}$$

and

$$NO + N \longrightarrow O + N_2 \tag{6}$$

Based on the assumption that the individual concentrations are determined by (1) and (2), and the rate of change of concentrations by the combined effects of (1), (2), (5) and (6), the following expressions are obtained for region II:

$$\frac{d}{dt}(NO) = -2k_5 (O)(NO) - k_{eff}(NO)^2 ; \tag{7}$$

and

$$\frac{d}{dt}(O) = (k_{eff} - k_1)(NO)^2 \tag{8}$$

For region III, the following equation is given:

$$\frac{1}{(O)}\frac{d}{dt}\Big[(O)(NO)\Big] = \frac{d}{dt}(NO) \tag{9}$$

Maximizing the equations for O and NO concentrations and imposing certain additional assumptions on (5) and (6), yields

$$(NO)_0\, t_m = \frac{1}{\sqrt{2(k_{eff} - k_1)\, k_5}} \tag{10}$$

Graphs for $\ell n(NO)_0 t_m$ as a function of 1/t are given (for pure NO and for 0.5% NO in argon). The experimental data of Freedman and Daiber (J. Chem. Phys., v. 34, 1271, 1961) for NO and O absorption are plotted, as well as chemical luminescence data obtained by the present authors. The reaction rate constant k_5 for (5) was derived from the experimentally determined t_m values and from previously computed reaction rate constants for (1) and (2). Reaction rate constant data at 5000°K were in good agreement with that of Wray and Teare. Taking the specific energy of activation in the low temperature region into account, these data are best described by the function:

$$k_5 = 1.3 \times 10^4\, T^{5/2} \exp - \left\{\frac{38700}{RT}\right\} \frac{cm^3}{mole \cdot sec} \tag{11}$$

A graph of k_5 as a function of temperature is shown in Fig. 2.

Figs. 1 and 2 on following page.

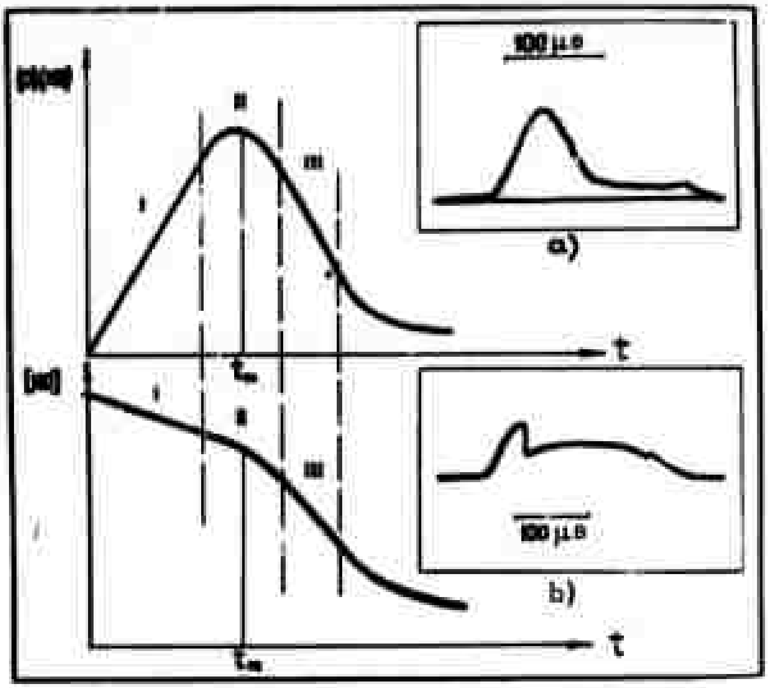


Fig. 1. Time dependence of NO and O and of NO concentrations behind the incident shock wave front in pure nitrogen oxide.
t_m = commencement of the chain reaction;
a- oscillogram for the NO_2 chemical luminescence intensity; b- absorption oscillogram in the (0.2) band of the NO γ-system.

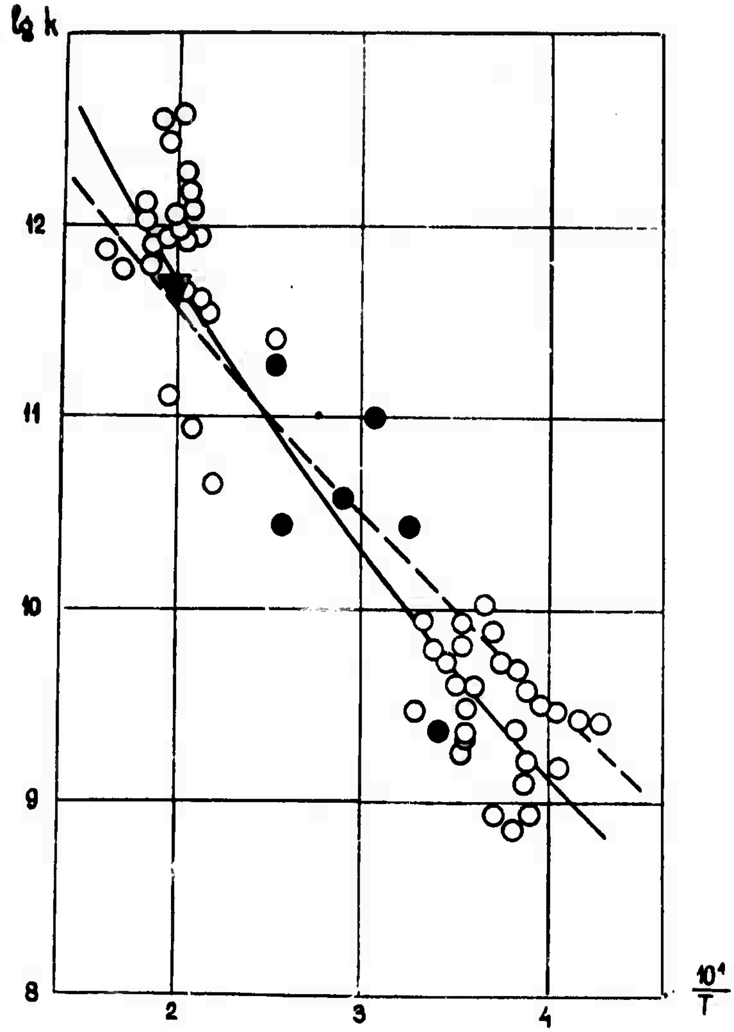


Fig. 2. Temperature dependence of k_5. Solid curve was computed by authors, dotted curve- taken from Wray and Teare (J. Chem. Phys., 36, 2582, 1962.
Experimental results: o = data obtained by authors; ● = data from Friedman and Daiber, and ▲ = data from Wray and Teare.

Khristoforov, B. D. Shock wave parameters for explosion of a spherical charge in porous NaCl. FGiV, no. 4, 1971, 594-599.

Laboratory experiments were conducted to determine the parameters of shock waves in a solid at various porosity values within the range $1 \lesssim \bar{R} \lesssim 9$, where $\bar{R} = R/R_0$ is the ratio of the distance R between the point of measurement and the charge to the charge radius R_0. The effect of rock porosity near an explosion on the explosion parameters in the medium was considered. NaCl powder with a grain size of about 0.3 mm was used to simulate the properties of natural rock. The powder was pressed to densities of $\rho_{00} = 2.12$, 1.87, and 1.72 g/cm^3, and the single-crystal density was $\rho_0 = 2.16$ g/cm^3. The porosity of the pressed specimens, defined by the ratio $\eta = 1 - \rho_{00}/\rho_0$, was 2, 13.5, and 20%. The shock-wave parameters were measured by an electromagnetic method proposed by Ye. K. Zavoyskiy. Results show that the porosity of the medium substantially affects the energy dissipation and the shock-wave parameters in the near explosion zone.

Khristoforov, B. D., Ye. E. Goller, A. Ya. Sidorin, and L. D. Livash. Manganin sensor for measuring shock wave pressure in solids. FGiV, no. 4, 1971, 613-615.

A manganin sensor and circuitry are described for recording plane shock wave pressure in a solid within the range 1 to 10^2 kbar. The plane shock wave in the specimen is actuated by a detonation lens (1, Fig. 1) and explosive charge (2). Variation of the charge density and the introduction

of layers of inert materials (3) between the charge and the specimen (4) permit shock wave pressure to be varied within wide limits. A cellophane film (5) protects the sensor wire (6) from deformations resulting from destruction of the specimen. Simultaneously, the pressure in the film, equal to the normal stress in the specimen, is established in about 0.2 microsecond. This is determined by a multiple of the time of passage of the wave along the film thickness. The static and dynamic sensitivity coefficients of the sensor were determined. The dynamic sensitivity coefficient was based on a comparison with results of electromagnetic measurements of shock-wave parameters in NaCl within the range of 3 to 50 kbar and during phase transition in KBr.

Electromagnetic measurement data show that in a phase transition in KBr: $u = 0.30 \pm 0.01$ km/sec, $N = 2.60 \pm 0.05$ km/sec; and $p = 21$ kbar. Under these conditions $S = 2.8 \times 10^{-3}$ kbar^{-1}. Values of $S = 2.5$, 2.8, and 3×10^{-3} kbar^{-1} were determined in NaCl specimens with $\rho_0 = 1.88$ g/cm^3 at pressures of 3.5, 6.4, 8.5, and 50 kbar. The dynamic sensitivity coefficient therefore exceeds the static coefficient. In the range above 6 kbar, the dynamic coefficient also increases with pressure in contrast to the static coefficient. This divergence is apparently due to differences in the stressed state of the manganin under two types of loading.

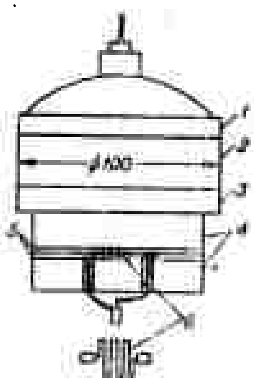


Fig. 1. Diagram of detonator and sensor

Boyko, M. M., V. A. Letyagin, and V. S. Solov'yev. Experimental investigation of shock wave attenuation in steel. ZhPMTF, no. 2, 1972, 101-104.

Shock wave attenuation in steel specimens from the contact blast of a plane-wave trotyl charge, with a 50 mm diameter and 10 mm height, was studied experimentally. Monotonic attenuation of the maximum shock-compression pressure was observed at increasing distances from the contact surface. Shock wave attenuation was caused by a relief wave which overtook the shock waves from the direction of the charge. The propagation rates of the primary and secondary shock waves were computed using the known shock-wave velocity and the experimentally obtained time intervals between the emergence of the waves to the free surface of variable thickness plates. The experiments show that up to a thickness of $x_1/h \approx 1.35$ (x_1, specimen thickness; h, charge height) the shock waves propagated in steel in three stages, and thereafter degenerated into a two-stage form.

Zak, M. A. Geometric shock waves in an anisotropic elastic body. MTT, no. 3, 1972, 161-162.

An investigation is made of a quasi-linear hyperbolic system of equations for wave propagation in an elastic anisotropic medium. Surface wave front equations of motion are derived and resolved with respect to coefficients of the first and second quadratic forms. A formula for the characteristic propagation rate of discontinuities of the surface form was obtained: $\lambda' = \mathrm{grad}\, \lambda \cdot n$, where $\lambda(N_1, N_2, N_3)$ is the characteristic velocity in the direction of

normal N with the directional cosines N_1, N_2, N_3; n is the unit vector of the normal of a discontinuity line of the surface form, in a plane tangential to the surface and forming an acute angle to the main normal. It is shown that if the line of discontinuity of the wave-front shape is an asymptotic curve, the discontinuities of the geodesic curvature of this curve are distributed at a constant rate; $\lambda'' = \text{grad}\, \lambda \cdot \tau$, where τ is the unit vector of a tangent to the discontinuity line, with unit vectors τ, M, n forming a right triangle. However, if the shape discontinuity line is not asymptotic, then $\lambda'' = 0$.

Investigation of the initial wave propagation equations in integral form permitted establishment of the propagation rate of fracture lines of a "ridge" type on the wave-front surface, and fracture points of a "peak" type on the discontinuity lines of the wave-front surface shape. The propagation rates coincide with the characteristic rates λ' and λ'', if the values of the discontinuities are infinitely small, but differ from them if the discontinuity values are finite.

It is shown that the characteristic velocities λ' and λ'' generally depend on those shape parameters which transport the weak discontinuities. This leads to the possibility of the formation of ridges and peaks, propagating in the form of shock waves at the rate $\lambda+'$ and $\lambda +''$ as a result of "accumulation" of the corresponding shape discontinuities, which are weaker than the discontinuities at the crests and peaks. It is emphasized that the shock waves obtained have a purely geometrical sense which characterizes the configuration of that region of the arguments in which movement of the medium is considered.

Alinovskiy, N. I., A. T. Altyntsev, and N. A. Koshilev. Heating of plasma ionic component by a collisionless shock wave. ZhETF, v. 62, no. 6, 1972, 2121-2128.

The energy spectra of plasma ions heated by a collisionless shock wave are obtained by passive corpuscular diagnosis. When an aperiodic shock front with resistive dissipation is formed in the plasma, ion heating appears as a small group of ions (about 10%) with a mean energy of the order of the electron temperature; the remaining ions are cold. Experimental results agree with a theoretical model, in which the origin of this group of particles is explained by the linear Landau damping of ion-acoustic vibrations in resonance ions located in the "tail" of the distribution function, induced in the shock front.

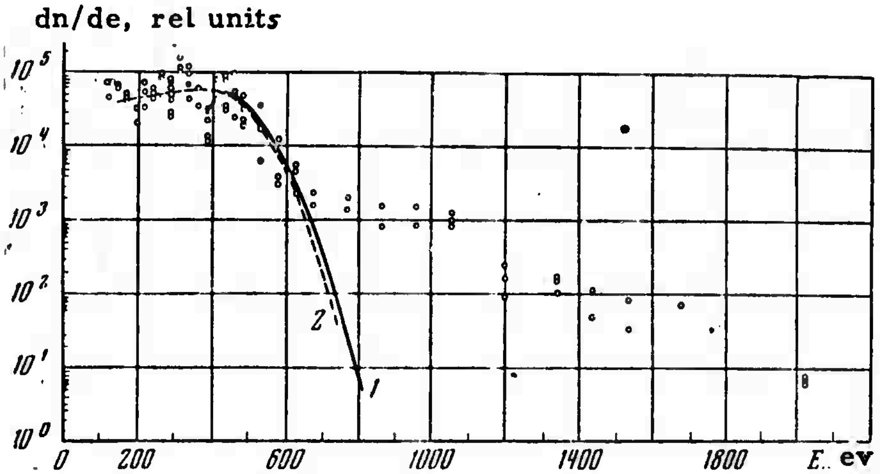


Fig. 1. Typical ion energy spectrum for low Mach numbers ($M < M_{cl}$). Parameters: $M = 1.8$, $h = 2$; $n = 1.4 \times 10^{13}$ cm^{-3}, $H_0 = 520$ oe. 1. Calculated approximation for constant ion velocity, $T_i = 6$ ev, $E_{H\,max} = 4.08$ ev. 2. Calculated approximation for increasing ion velocity, $T_i = 7.5$ ev, $E_{Hmax} = 480$ ev.

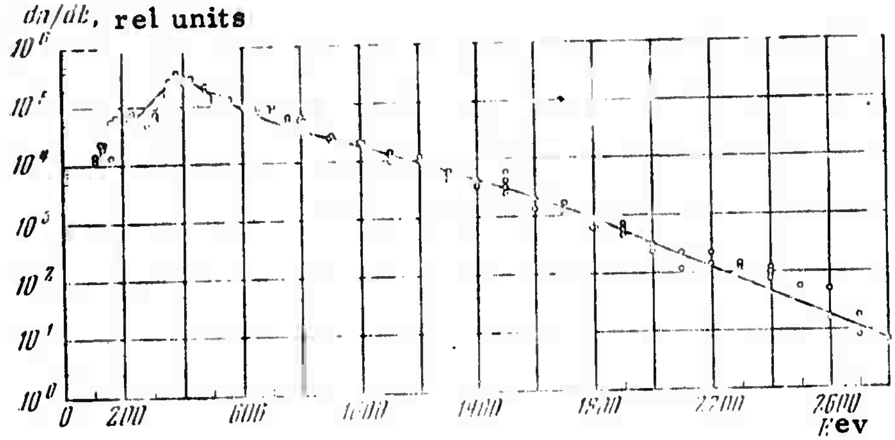


Fig. 2. Typical ion-energy spectrum for the case of $M \gtrsim M_{c2}$. Parameters: $M = 4.5$, $h = 5.4$, $n = 7 \times 10^{13}\ cm^{-3}$ $H_0 = 280$ oe. Solid line - calculated curve. $T_1 = 12$ ev, $T_2 = 130$ ev, $E_{H\ max} = 380$ ev, $n_2/n_1 \approx 8$.

The main energy content of the plasma is determined by the electron component. Under the conditions of "overturning" of the shock-wave front, predominant heating of the ion component of the plasma is observed, and the ion distribution function is close to an isotropic Maxwell distribution.

Tsvetkova, M. V. Characteristics of supersonic flow around blunt bodies under conditions of intensive injection. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev, Kiyevskiy universitet, 1971, 112-115. (RZhMekh, 5/72, no. 5B415)

Results are presented of experimental research on the effect of air injection through a permeable body surface on the position and shape of the shock wave, the surface pressure distribution, and the wave resistance of the body. The research was performed on a cylinder with spherical bluntness, and on a truncated cone with a developing break. The surface porosity was 60%, the Mach numbers were M = 3-5, and the relative flow rate of the injected gas was varied within the limits of 0 to 1.0. Two experimental regimes were established: a regime with moderate injection intensity (relative flow rate less than 0.2) and a regime of "strong" injection (flow rate greater than 0.2). In the moderate flow regime, a sharp change of the flow characteristics takes place as the rate is increased (increased resistance, shock-wave separation, and increased angle of shock-wave incidence). The flow calculation can therefore be conducted on the basis of boundary-layer theory, taking viscous interaction into account. The regime of "strong" injection is characterized by the presence of a boundary "blow-off" region of the boundary layer. In this case the flow parameters cannot be determined on the basis of boundary-layer theory.

Biberman, L. M., S. Ya. Bronin, and A. N. Lagar'kov. Heating and flow around blunt bodies during atmospheric entry. IN: Trudy Sektsii po chislennym metodam v gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, 1969, Moskva, v. 3, 1971, 134-153. (RZhMekh, 5/72, no. 5B424)

The problem of the aerodynamic heating of blunt bodies entering the atmosphere at velocities higher than parabolic is considered. A detailed justification is given of the theoretical assumptions, permitting an efficient solution to the problem of determining the total heat flux at the critical point of a blunt body. Thus, for hypersonic flight velocities, the assumption of small width of the shock layer in comparison to a characteristic dimension of the body is valid. It becomes possible to describe the flow distribution near the critical point by systems of ordinary differential equations. Considerations are presented for disregarding the viscous structure of the shock wave so that the problem is solved without separating the shock layer into a nonviscous region and a boundary layer. It is noted that the final expression for the total heat flux at the critical point contains only values obtained from the solution to the "nonviscous" problem with allowance for gas radiation in the shock wave, as well as other values from the solution to the "viscous" problem, but with radiation ignored. An iteration method is used to solve the integro-differential system of equations. Graphic results are presented of computer--aided calculations of the relationships of the total heat flux and its convective and radiant components owing to variation of the flight velocities (to 20 km/sec) and the nose curvature radius at the critical point.

Sil'vestrov, V. V., and V. P. Urushkin. Method for determining density of high speed gas jets. IN: Dinamika sploshnoy sredy. Novosibirsk, no. 7, 1971, 125-129. (RZhMekh, 5/72, no. 5B477)

A method is proposed for determining the density of gas jets moving at a speed of 8-12 km/sec. The jets are formed from the detonation of an explosive in a channel. The method is based on an experimentally obtained law of the motion of a propelled body, using a steel ball. The successive positions of the ball in a chamber are recorded by x-ray pulse photography. The characteristics of the x-ray facility were such that the minimum size of the steel ball was 2 mm. The proposed method made it possible to determine the boundaries of the potential values and the characteristics of the three-dimensional distribution of the gas-jet density with an error of 8-10%. A significant nonuniformity of density distribution of the cross section and jet length was revealed. The maximum value of gas density attained was 0.2-0.23 g/cm^3.

Davlet-Kil'deyev, R. Z. Heat and flow characteristics of a body of revolution in a supersonic gas flow. IN: Uchenyye zapiski Tsentral'nogo aero-gidrodinamicheskogo instituta, v. 2, no. 6, 1971, 103-107. (RZhMekh, 5/72, no. 5B556)

The results are presented of an experimental investigation of flow and heat on the surface of a conic nose cylinder with a half-angle of 13.5°. Tests were carried out in a thermal wind tunnel at angles of attack $\alpha = 0^\circ$, 10°, and 20°, $N = 5$, and $R_\infty = 10^7\ m^{-1}$. The heat flow was measured by the method of heat-indicating coatings; the flow pattern was determined on the basis of washed-out points and the results of heat

transfer measurements. At $\alpha = 0^{o}$ and 10^{o}, the heat flow agreed with calculations for laminar flow; the flow around the body was detached. At $\alpha = 20^{o}$ the flow became detached and a zone of increased heat fluxes appeared on the lee surface. Two three-dimensional expanding funnel-shaped vortices simultaneously appeared above the zone.

Turanov, Ye. N. Heat evolution at a concave surface in supersonic flow. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev. Kiyevskiy universitet, 1971, 168-172. (RZhMekh, 5/72, no. 5B998)

Heat exchange on the concave frontal surfaces of axisymmetric bodies was investigated at Mach numbers M = 2.5, 3.0, and 3.5. The concave surface was spherical and varied in depth from 0 to R, where R is the radius of the maximum cross section of the body. The shock wave in front of the concave body pulsated at a frequency of 1 kHz. The heat exchange on the axis of symmetry of the concave surface was on the same order as that on the surface of the flat face. Tests were also conducted on models with through apertures in the concave surface.. At the relative aperture area of 6-10%, the pulsations ceased. The heat flux at the critical point in this area was less than at the critical point of a flat face and varied approximately in accordance with a linear law as a function of cavity depth.

Pavlov, B. M. Solution to complete Navier-Stokes equations in problems on flow around blunt bodies. IN: Trudy sektsii po chislennym metodam v gazovoy dinamiki 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, 1969. Moskva, v. 1, 1971, 55-66. (RZhMekh, 5/72, no. 5B887)

Numerical solutions to complete Navier-Stokes equations are obtained for problems of the flow and heat exchange of a viscous gas around various bodies (a sphere, a right circular cylinder, an ellipsoid, a hyperboloid of revolution, and a blunt cone) for Reynolds numbers $R \leq 10^3$ and Mach numbers $2 \leq M_\infty \leq 15$. Calculation results revealed a weak upstream transmission of the perturbation; this permitted calculation of the flow field on the windward side of the body in the stream independently of the flow on the lee side. The solutions are sought using an explicit difference scheme by the method of adjustments. The density, pressure, and heat flow characteristics, the resistance coefficients, and the position of the shock wave and of the sonic line are listed for various values of R and M. Good agreement with experimental data for $R>10$ is indicated.

Stulov, V. P., G. F. Telenin, and L. I. Turchak. Supersonic flow around blunt bodies by various gas mixtures with high speed chemical reactions. IN: Trudy sektsii po chislennym metodam v gazovoy dinamiki 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, 1969. Moskva, v. 3, 1971, 3-28. (RZhMekh, 5/72, no. 5B1114)

A numerical method is proposed for the calculation of flow near the frontal part of axisymmetric blunt bodies in various gas mixtures, undergoing nonequilibrium chemical processes. Underlying the method

is the notion that the total system of the equations of relaxation gas dynamics is divided into two systems, one of which (the equations of motion) is solved by the conventional method, while an implicit difference scheme along the streamline is used for solving the relaxation equations. The problem is solved by iteration between the systems at each calculated layer. The proposed method makes it possible to investigate flow with an arbitrary degree of unevenness. The calculations assume that the hypersonic flow around the body. was at a zero angle of attack and that a separation shock wave is formed in front of it. All the internal degrees of freedom of the gas-mixture particles, including the oscillatory degrees are considered to reach equilibrium at the shock-wave front. The calculation results are presented graphically.

Air flow in a blunt sphere was investigated under conditions in which only oxygen dissociation was significant in the chemical reactions. The validity of binary similarity (similarity of flow at a constant product of the characteristic linear dimension on the free-stream density) was verified under a wide range of conditions. A justification is given for the selected physicochemical model of air for the given range of free-stream parameters ($M = 8$ to 15). Consideration is given to the nonequilibrium flow of a mixture of carbon dioxide, nitrogen, and argon. A strong dependence of the flow upon the initial concentrations of the mixture components is shown. The regularity of flow transition to equilibrium is verified. Questions on selection of the physicochemical model and the kinetics of a given mixture are analyzed.

Perminov, V. D., and Ye. Ye. Solodkin. Axisymmetric bodies with minimum resistance at a specific heat flow to the surface. IN: Uchenyye zapiski Tsentral'nogo aero-gidrodinamicheskogo instituta, v. 2, no. 6, 1971, 32-40. (RZhMekh, 5/72, no. 5B345)

For axisymmetric bodies with a flat leading edge and a mildly sloping lateral surface, an approximate solution is given to a variational problem of the shape of a body of minimal resistance in a hypersonic gas under a specific total heat flow to the surface. A modified Newtonian formula is used for calculation of the pressure distribution. The formulated isoperimetric problem of the shape of an axisymmetric body of given dimensions with a flat leading edge, and minimum resistance at a given total heat flux, is solved numerically by a modified method of local variations at values of $M_\infty = 6$, 10, and 30, and $R_O = 10^6$. It is shown that, under the specified conditions, the requirements of minimal resistance and minimal heat flow to the body surface are contradictory.

Popov, F. D., and I. M. Breyev. Calculation of supersonic flow around blunt bodies by the finite-difference method. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev, Kiyevskiy universitet, 1971, 50-55. (RZhMekh, 5/72, no. 5B336)

A finite-difference scheme is proposed for the calculation of static, mixed, axisymmetric flow over the nose section of a blunt body in a supersonic ideal gas. The shock layer considered is transformed

into a rectangular region, a difference grid is introduced, and the equations of the problem are represented in difference form with second-order of accuracy. The system of nonlinear difference equations is solved by the method of successive approximations. Each iteration deals with a system of linear equations, to which the method of successive elimination is applied. In contrast to the numerical method of Babenko, et al. (Babenko, Voskresenskiy, Lyubimov, and Rusanov . Prostranstvennoye obtekaniye gladkikh tel ideal'nym gazom. Three-dimensional flow around smooth bodies by an ideal gas . Moskva, Nauka, 1964, RZhMekh, 1965, 4B207K), the system of difference equations in the iteration process is not broken down into equations along individual radial lines, but is solved simultaneously for the entire region. The method of successive matrix elimination is also generalized for the case of cell matrices. Damping is used to accelerate iteration convergence. Some calculation results are presented to illustrate the convergence of the numerical solution.

Molodtsov, V. K., and A. N. Tolstykh.
Calculation of supersonic viscous flow around blunt bodies. IN: Trudy Sektsii po chislennym metodam v gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, Moskva, v. 1, 1971, 37-54. (RZhMekh, 5/72, no. 5B335)

Supplementary results are presented to calculations using Navier-Stokes equations of hypersonic flow around a spherically blunt model by methods proposed earlier by the authors (Tolstykh, A. ZhVMMF, no. 1, 1966, 113-120, RZhMekh, 1966, 8B257; Molodtsov, ZhVMMF, no. 9, 1969, 1211-1217, RZhMekh, 1970, 2B384). The calculations were for $M_\infty = 10$ and various Reynolds numbers, and a temperature factor and index ω within the law of the relationship of the viscosity coefficient to temperature,

$\mu \sim T^{\omega}$. A brief analysis is given of the calculation results (presented in 10 figures), as well as a comparison with experimental and other theoretical data.

Kukarkina, M. A., and Yu. B. Radvogin. Application of a divergent scheme for solution of flow problems. Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev. Kiyevskiy universitet, 1971, 66-72. (RZhMekh, 5/72, no. 5B334)

A modification is proposed of a known method of calculating supersonic gas flow (Babenko, Voskresenskiy, Lyubimov, and Rusanov. Prostranstvennoye obtekaniye gladkikh tel ideal'nym gazom. Three-dimensional flow around smooth bodies by an ideal gas . Moskva, Nauka, 1964. RZhMekh, 1965, 4B207K). The modified equations of gas dynamics are written in divergent form and in a conversion to new independent variables which permit the interval length of the difference grid, in terms of physical units, to be decreased without difficulty in regions of acute change of the parameters. Examples of flow around two complex bodies at M = 10 show that the method may be used for the calculation of flow with large gradients of gas-dynamic values.

Katskova, O. N., and P. I. Chushkin. Three-dimensional supersonic flow around bodies by a gas with nonequilibrium physico-chemical transformations. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev. Kiyevskiy Universitet, 1971, 63-69. (RZhMekh, 5/72, no. 5B332)

A scheme proposed earlier by the authors is applied to the investigation of supersonic nonequilibrium flow in a three-dimensional nozzle and near the tail section of a blunt body in the shape of an inverted cone. The numerical scheme is obtained by representing the relationships of the desired functions to the angular variable ψ of a cylindrical system of coordinates by trigonometric polynomials along ψ with interpolation points on a series of meridional planes ψ= const. For determination of the desired functions, an approximating system of differential equations of two independent variables is consequently obtained on all the meridional planes of interpolation. At supersonic speeds this system is hyperbolic, with two sets of wave characteristics (Mach lines) and a family of flow-line analogs on each interpolation plane, and is solved by an inverse scheme of the method of characteristics. Calculation is performed in accordance with layers of x = const, where x is measured along the axis of the cylindrical system of coordinates.

The calculated examples are of nonequilibrium flow of dissociated oxygen. The nozzle had a cylindrical external generatrix of elliptical cross section, as well as an elliptical (narrowing) central body. The calculations revealed a "freezing" of the gas composition during expansion in the nozzle. In calculating nonequilibrium flow around a blunt body with a tail section in the shape of an inverted cone, various half-angles of the cone, $\omega = 0^{\circ}$, 10°, and 30°, and two angles of attack $\alpha = 10^{\circ}$ and 15°, were considered. It is noted that nonequilibrium oxygen dissociation causes a

significant temperature drop and a density increase in comparison to the case of a perfect gas. The simultaneous effect of disequilibrium on pressure and, consequently, on the aerodynamic characteristics of the investigated bodies is slight. It was established that the gas composition near the body surface on the conical tail section becomes practically frozen.

Bulakh, B. M. Vortex interaction of a three-dimensional laminar boundary layer on a circular cone with external nonviscous supersonic flow. IN: Materialy nauchno-tekhnicheskoy konferentsii Leningradskogo instituta svyazi. Leningrad, no. 4, 1971, 146-147. (RZhMekh, 5/72, no. 5B329)

The velocity, pressure, density, and temperature components in a laminar boundary layer flowing around a cone at an angle of attack are represented in the form of expansions into a power series on the basis of the small parameter $\epsilon = R^{-\frac{1}{2}}$, where R is the Reynolds number. The initial terms of the expansions describe a self-similar solution to a problem of the boundary layer on the cone; the coefficients of the second term take into account the boundary layer interaction with a nonviscous eddy flow outside the boundary layer. Corrections to the solution associated with this interaction may in some instances be 10% or higher.

Balakin, V. B., and V. V. Bulanov. Numerical solution to a problem on shock wave interaction with a cylinder in supersonic flow. I-FZh, v. 21, no. 6, 1971, 1033-1039. (RZhMekh, 5/72, no. 5B327)

A difference scheme of a second order of exactness is proposed for the calculation of the axisymmetric unsteady flow of an ideal gas. A numerical solution is obtained to the problem of a shock wave impacting a cylinder in supersonic flow. In the first stage of solution, the problem of streamline flow is solved by the method of adjustment. In the second stage the problem of shock interaction is solved. Pulsed pressure values were calculated for regimes with Mach numbers within the range of 1.5 to 5.

Antonova, A. M. High speed gas flow around a slender three-dimensional body. Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev, Kiyevskiy universitet, 1971, 99-102. (RZhMekh, 5/72, no. 5B340).

A formulation of the problem of flow around a slender body by a hypersonic gas is described. Within hypersonic theory of small perturbations, the problem can be reduced to the solution of a quasi-linear second-order equation in terms of partial derivatives of the hyperbolic type for a flow function in a plane of similarity variables. An iteration method of solving a Cauchy problem for this equation is proposed which reduces to an inverse problem for the flow around a slender pointed body with an attached shock wave.

Vasil'yev, M. M. Supersonic flow around a cone at an angle of attack. Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev. Kiyevskiy universitet, 1971, 75-78. (RZhMekh, 5/72, no. 5B338)

The method reported earlier by the author (MZhiG, no. 1, 1970, 33-39, RZhMekh, 1970, 6B240) is used to solve the problem of supersonic flow around a cone at an angle of attack with an accuracy to values of the second order of smallness, inclusively. The results are compared with a solution of the problem by a method of nets of Babenko, et al. (Babenko, Voskresenskiy, Lyubimov, and Rusanov. (Prostranstvennoye obtekaniye gladkikh tel ideal'nym gazom. Three-dimensional flow around smooth bodies by an ideal gas). Moskva, Nauka, 1964, RZhMekh, 1965, 4B207K), and with the solution obtained by the method of expansion into a double series by Sapunov(IN: Transzvukovyye techeniya gaza. Transonic gas flow. Saratov. Saratovskiy universitet, 1964, 164-177, RZhMekh, 1965, 9B231).

Kosorukov, A. L. Supersonic flow around smooth bodies with relaxation. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev. Kiyevskiy universitet, 1971, 70-74. (RZhMekh, 5/72, no. 5B337)

Steady flow around an axisymmetric blunt body by a nonviscous, nonthermally conductive gas is solved by the method of adjustments, with account taken of oscillatory relaxation. To reduce the difficulties of solving relaxation equations, the author divides the initial system into two subsystems: 1) equations for the velocity and pressure components, and

2) equations for the temperature and the oscillatory energy. The first system of equations is solved by the Euler method. In the second system the free term is dependent on the desired values, and the nonlinear difference equations obtained are solved by the Newton method. The method contains two iteration processes. Flow of the mixture O_2, N_2, and Ar (air) around a sphere and ellipsoids is calculated for various initial conditions.

Maykapar, G. I. Calculating the resistance of a body on the basis of the shape of the bow shock wave. IN: Uchenyye zapiski Tsentral'nogo aero-gidrodinamicheskogo instituta, v. 2, no. 6, 1971, 23-31. (RZhMekh, 5/72, no. 5B344)

Using theorems of the conservation of mass and momentum, an analysis of the order of the magnitudes and the numerical results confirmed the validity of a formula for computing the wave resistance of a semi-infinite cylindrical body based on the shape of the bow shock wave. The formula may be used for determining the resistance of the leading sections of axisymmetric and cylindrical bodies on the basis of flow shadow photography.

Babenko, K. I., V. N. Ivanova, E. P. Kazandzhan, M. A. Kukarkina, and Yu. B. Radvogin. <u>Nonsteady flow around the leading section of a blunt body</u>. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev, Kiyevskiy universitet, 1971, 29-43. (RZhMekh, 5/72, no. 5B325)

A numerical solution is given for the problem of supersonic flow around the leading section of a blunt body with a plane of symmetry in inert gas flow. A normalizing system of curvilinear coordinates is used, in which the calculated region has fixed boundaries. A finite-difference method is generalized and developed similar to an established one. The principal variation of the proposed method is associated with calculation of the frontal shock wave and the construction of a well-defined system of difference equations. Finite-difference approximation is employed for the derivatives together with the corresponding equation coefficients. The nonlinear system of difference equations obtained is solved by an iteration method, the complete system being divided into subsystems pertaining to each of the three spatial variables. The indeterminate form of the difference equations on the zero radial line is shown. The algorithm developed is used for the determination of steady supersonic flow around triaxial ellipsoids and ellipsoids of revolution. Results of numerical calculations are presented.

Fedotov, B. N. and G. G. Skiba. Nonstationary three-dimensional motion of bodies of revolution in an ideal gas. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanike, teploobmenu i massoobmenu. Sektsiya "Aerodinamika bol'shikh skorostey". Kiyev. Kiyevskiy universitet, 1971, 44-49. (RZhMekh, 5/72, no. 5B326)

A boundary-value problem is considered for equations of three-dimensional nonsteady motion with boundary conditions on shock wave and body surfaces. In the selected system of coordinates, the functions characterizing the nonsteady motion of the body are the angle of precession, the angle of nutation, two components of the vector of angular velocity, and the velocity of the origin of coordinates. A sinusoidal relationship of the perturbation functions to time is postulated. The expressions of the fundamental functions are substituted into the initial equations. Linearization led to the reduction of the problem to the solution of a nonlinear system and a series of linear systems with coefficients dependent on the solution to the nonlinear system. A brief description is given of the procedure for solving the three-dimensional boundary-value problem with application to smooth bodies of revolution with spherical bluntness, with oscillations centered in the center of sphere. The scheme of G. F. Telenin, et al. is applied in the region adjoining a sphere. (Gilinskiy, Telenin, and Tinyakov, IAN SSSR. Mekhanika i mashinostroyeniye, no. 4, 1964, 9-28. RZhMekh, 1965, 5B263), while in the region between the shock wave and a conic surface the difference method of Babenko, et al is applied. (Babenko, Voskresenskiy, Lyubimov, and Rusanov. Prostranstvennoye obtekaniye gladkikh tel ideal'nym gazom. Three-dimensional ideal gas flow around smooth bodies by an ideal gas. Moskva, Nauka, 1964, RZhMekh, 1965, 4B207K).

Kryukova, S. G., and V. S. Nikolayev. <u>Experimental investigation of optimally balanced profiles in viscous supersonic flow.</u> IN: Uchenyye zapiski Tsentral'nogo aero-gidrodinamicheskogo instituta, v. 2, no. 5, 1971, 94-98. (RZhMekh, 5/72, no. 5B377)

The optimal shapes of three classes of profiles with a given location of the balancing center of pressure were investigated in viscous hypersonic flow stream ($M_{\infty} = 5.2$, $R = 150$). The upper boundary of the quality factor as a function of the location of the center of pressure is found for the profiles under consideration. The experimental results are compared with theoretical data calculated by one of the authors (Nikolayev. Uchenyye zapiski Tsentral'nogo aero-gidrodinamicheskogo instituta, v. 1, no. 6, 1970, 67-74, RZhMekh, 1971, no. 10B229).

Rakhmatulin, Kh. A., and S. I. Mevlyudov. <u>Supersonic flow around a slender body in a two-phase mixture.</u> IN: Voprosy vychislitel'noy i prikladnoy matematiki, Tashkent, no. 9, 1971, 166-175. (RZhMekh, 5/72, no. 5B1204)

The problem of supersonic flow around a slender profile or body of revolution by a two-phase mixture is considered in an approximation of linear theory. A model of the interpenetrating motion of two or three interacting continuous media (components) is used. Instead of an equation of energy of the gas or mixture, an assumption of barotropicity is used; i.e., the pressure perturbation p is considered to be a known function

of the density perturbation of the mixture

$$\rho = \sum_{n=1}^{N} \rho_n,$$

where ρ_n is the density of the corresponding component, and N is the number of components. In the solution, the entire region of the perturbed flow is divided into two subregions (I) and (II). To subregion (I), bounded by the bow wave (in the linear approximation, by a characteristic curve) and a dividing line (the trajectory of the particles reflected from the leading edge of the body), a two-velocity model is applied. To subregion (II), bounded by the dividing line and the body surface, a three-velocity model is applied, in which the third component is the particles reflected from the body in accordance with the law of specular reflection. Formulas which yield a solution in the indicated regions are presented. When obtaining a solution in region (II), use is made of an expansion into a series along the y coordinate, which is normal to the free-stream flow.

Mevlyudov, S. I. <u>Linear theory of supersonic flow around a slender body in a two-phase mixture</u>. IN: Voprosy vychislitel'noy i prikladnoy matematiki, Tashkent, no. 9, 1971, 156-165. (RZhMekh, 5/72, no. 5B1203)

In a formulation analogous to the preceding work by Rakhmatulin and the author, a linear problem is considered of the flow of a two-phase mixture around a slender two-dimensional or axisymmetric body. The author in this work assumes that the equation

$$\sum_{n=1}^{N} \rho_{n0}\left(\frac{\partial u_n}{\partial y} - \frac{\partial v_n}{\partial x}\right) = 0$$

where u_n and v_n are a projection of the velocity vectors of the corresponding components on the x and y axes; N is the number of components, while ρ_{n0} are unperturbed values of their densities, permitting the flow of each component to be considered irrotational and accordingly the introduction of a perturbation potential for each component. The remainder of the investigation is done using operational calculus methods.

Gadion, V. N., V. G. Ivanov, G. I. Mishin, S. N. Palkin, and L. I. Skurin. Electronic and gas dynamic parameters of hypersonic wakes behind models moving in argon. ZhTF, no. 5, 1972, 1049-1055.

The conductivity, velocity, and width of hypersonic wakes behind models moving in argon were studied within a velocity range of 3300-4900 m/sec, at pressures of 30, 40, 60, 80, and 100 torr and a temperature of about 290° K. The experiments were conducted on polyethylene 8 mm cylindrical models of small elongation with spherical noses and conic skirts. Copperplated aluminum spheres 5.4 mm in diameter were used for control experiments. The models were shot into a pressure chamber provided with instrumentation for measurement of the wake conductivity and velocity. Wake velocity was measured electrodynamically and by the Toepler method.

Measurement results are presented for tests of wake conductivity at a constant pressure and variable velocity or at a constant velocity and variable pressure. The latter test results show that as the distance from the body increases, a relationship develops between the conductivity σ and the pressure in the mainstream. In the far wake ($x/d > 150$-200, where d is the diameter of the cylindrical part of the model), this relationship approaches

$$\sigma \sim \frac{1}{\sqrt{P_\infty}}.$$

Relationships of the electron density drop N_e to the distance along the wake are plotted in terms of x/d. The electron-collision frequencies data were determined taking electron velocity distribution into account.

On the basis of the experimentally obtained initial conditions, changes of the wake temperature, velocity, diameter, and electron concentration are calculated using different models of viscosity. The theoretical and experimental data are compared for a wake sector up to 500 calibers (x/d) in length.

Andriankin, E. I., V. K. Bobolev, and A. V. Dubovik. Collapse of an elliptic cavity and explosive initiation in a liquid layer under shock effect. ZhPMTF, no. 5, 1971, 78-85.

Analytical and experimental results are given on the effect of shock excitation of a combustible liquid volume. Criteria are developed for the threshold conditions under which a nominally spherical fluid volume shifts to an elliptical form, and on further compression develops into a cumulative jet; in the limit this results in detonation from adiabatic heating of gas evolved in the volume. Test data on shock generation of jets in liquid nitroglycerine are included, and show qualitative agreement with theoretical results.

Shtessel', E. A., K. B. Pribytkova, and A. G. Merzhanov. A numerical solution to the problem of a thermal explosion, with free convection taken into account. FGiV, no. 2, 1971, 167-178.

The authors cite previous works in which the effect of free convection on a gas explosion process is expressed in terms of the Rayleigh (Ra) and Frank-Kamenetsky (δ) criteria. The analysis is extended here to the case of liquid fuel combustion, and is presented as a supplement to earlier experimental work by Merzhanov and Shtessel' (FGiV, no. 1, 1971) in which an empirical correlation between Ra and δ was obtained. The model used assumes an ideal stationary fluid in a uniform semi-infinite vessel; gas evolution is neglected. The results are shown graphically, indicating the conditions under which convection will or will not affect the detonation process.

Trufakin, N. Ye., and V. M. Borovikov. Explosive pressure sensor. Otkr izobr, no. 15, 1972, no. 337667.

The sensor comprises a steel cylindrical rod, on which two tensoresistors are attached. The rod is enclosed in a protective pipe, with a paraffin-filled radial clearance. To expand the measurement range, one of the tensoresistors is located in a region of plastic deformation, while the other is in a region of purely elastic deformation.

Bezmenov, V. Ya., and P. I. Gorenbukh. Application of a nonstationary analogy to an investigation of explosive wave effects on an obstacle in a hypersonic tunnel. Uchenyye zapiski Tsentral'nogo aerodinamicheskogo instituta, v. 2, no. 6, 1971, 48-54. (RZhMekh, 5/72, no. 5V282)

The results are presented of an experimental investigation of shock wave interaction from a blunt body (a plate with a blunt leading edge), with a solid boundary (a plate with a sharp leading edge), in a helium stream at M = 23 to 27. The pressure distribution around the plate with the sharp leading edge behind the incident shock wave is given. By means of a detonation analogy, the results obtained are used to analyze the effect of a plane shock wave on a two-dimensional barrier. It is shown that in this case the experimental results agreed with the calculated data. Counterpressure was not taken into account during the tests.

Zubkov, P. I., L. A. Luk'yanchikov, and B. S. Novoselev. Electric conductivity in the detonation zone of condensed explosives. FGiV, no. 2, 1971, 295-299.

Experimental data on determination of the conductivity distribution in a detonation zone are presented. Measurements were made for detonation of powdered 1.1 g/cm^3 PETN and 1.2 g/cm^3 hexogene. The electrical field was provided by explosive charges on the plates of a flat capacitor. The charge was initiated at the center through an opening in one of the plates; the detonation wave front is assumed to be cylindrical. The current and voltage between the plates was measured by oscilloscope. The resistance remained practically constant; the mean residual resistance was 0.3 x 10^{-3} ohm x cm. Fig. 1 shows averaged graphs of conductivity in the detonation wave for

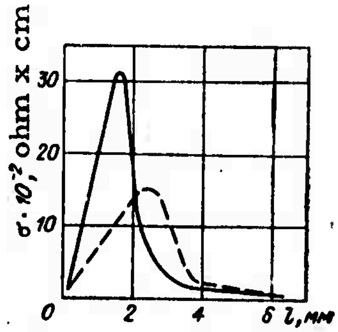


Fig. 1. Conductivity in the detonation zone.

hexogene (solid curve) and PETN (dotted curve). Possible causes of the origination of conductivity in the detonation wave are analyzed in terms of ionic and electronic conductivity. It is concluded that ionic conductivity is unlikely due to the chemical reaction.

Bayev, V. K., B. N. Kondrikov, V. P. Korobeynikov, V. V. Mitrofanov, R. I. Soloukhin, and M. Ye. Topchiyan. Research on explosion gas dynamics and reacting systems. FGiV, no. 2, 1971, 311-317.

The Third International Colloquium on explosion gas dynamics and reacting systems took place on September 12-17, 1971 in Marseilles, France. Basic topics of theoretical and experimental research reported on were in the field of unsteady dynamic gas flow, accompanied by physicochemical transformations of the medium; gas-dynamic aspects of detonation; and problems of the physics and chemistry of rocket-fuel combustion and working processes in engines. The colloquium also dealt with the gas dynamics of explosions in space. The conference was divided into seven sections: a) space phenomena, b) vortex flow, c) explosion gas dynamics, d) detonation, e) shock waves, f) gas-liquid systems, and g) reacting systems. V. P. Korobeynikov gave a gas-dynamic description of the motion and explosion of meteorites on the basis of the supposed explosion pattern of the Tungusskiy meteorite.

A session on twisted flows included a joint report by four U.S. delegates and V. P. Korobeynikov on the influence of heat conduction and viscosity on wave propagation from a powerful explosion. A. A. Vasil'yev, T. P. Gavrilenko, and M. Ye. Topchiyan described planned experimental research on the position of the Chapman-Jouguet plane in a multifront detonation wave in gas. V. P. Korobeynikov, G. G. Chernyy, et al. presented a theoretical analysis and an example of a numerical calculation of the point initiation of a detonation for the plane, cylindrical, and spherical cases. A report by I. V. Babaytsev, B. N. Kondrikov, and V. F. Tyshevich on low-velocity processes in high density charges described low velocity detonations in cast and pressed materials.

R. I. Soloukhin discussed IR-spectroscopy methods in high-temperature gas dynamics, including applications of emission and absorption IR-spectroscopy in the study of nonequilibrium processes in shock waves. R. Emrich (USA) and R. I. Soloukhin reported on the resonance absorption of 3.39 micron laser radiation by methane molecules in shock wave compressed gas. C. Brochet (France) and R. I. Soloukhin examined the occurrence and location of unstable zones in the chemical reaction behind an incendiary shock wave front.

The 65 papers presented in the colloquium will be published in a special number of the journal of the International Academy of Astronautics, "Astronautica Acta."

Batsanov, S. S., Ye. V. Dulepov, E. M. Moroz, L. V. Lukina, and V. V. Roman'kov. Effect of explosions on materials. Shock compression of rare earth metal fluorides. FGiV, no. 2, 1971, 266-269.

Results of a study of shock compression of ten rare earth metal (REM) fluorides and yttrium fluoride are presented. It is shown that the greatest physical characteristics change occurs using 30-50 g hexogene charges, with the exception of CeF_3 and PrF_3 for which the most significant changes occur using 100-150 g charges. All the shock-compressed materials displayed optical anisotropy, since the initial materials were finely dispersed and therefore were pseudoisotropic. The new phase is normally inhomogeneous, and the properties change occurs (or accumulates) in different grains with varying intensity; the value of the effect is maximal only in a small number of crystalline particles. Table 1 shows refractivity indices of the new phases;

a Соединение	b Исходное вещество			c Обжатое вещество		
	d_4^{25}, g/см³	ε	n_D	d_4^{25}, g/см³	ε	n_D
LaF_3	5,87	13,7	1,60	5,87	14,5	1,57
CeF_3	6,03	14,1	1,61	5,79	16,2	1,58
PrF_3	6,09	14,8	1,62	5,90	21,0	1,58
NdF_3	6,17	16,0	1,60	5,84	22,0	1,58
$SmF_3+0,5\,H_2O$	5,75	16,0	1,60	6,47	16,6	1,57
EuF_3	6,76	11,7	1,58	6,73	13,2	1,68
GdF_3	6,87	10,8	1,58	6,78	12,0	1,56
TbF_3	6,78	12,2	1,58	6,45	13,7	1,54
DyF_3	7,21	10,8	1,58	7,00	11,7	1,53
HoF_3	7,44	10,6	1,58	7,39	11,0	1,54
YF_3	5,02	11,2	1,56	4,90	11,7	1,53*

Table 1. a - compound, b - initial material, c - compressed material

measurement precision by the immersion method is ± 0.003, with results rounded to the second decimal place. An exception is EuF_3.

The compressed REM fluorides density decrease was generally due to the formation of internal defects. For a partial phase transition from the rhombic modification to the hexagonal, which should be accompanied by a density increase, the formation of imperfections also brings about a EuF_3 specimen density decrease. The dielectric permeability increased but in a different manner after shock compression. This increase was primarily caused by the appearance of defects. No marked changes of electrical conductivity due to the shock compression were observed. The conductivity was ionic in all cases, reflecting the absence of surface imperfections. Shock-compressed fluorides of La, Ce, Pr, Nd, Gd, Dy, and Y manifested no changes in atomic structure, but polymorphic conversions were observed in Sm, Ho and Eu fluorides. In the case of EuF_3 an inverse phase transition occurred in the form of increased hexagonal modification. Comparative data show that temperature is not the only determining factor in the stabilization of this modification.

Barzykin, V. V., V. A. Veretennikov, Yu. M. Grigor'yev, and A. S. Rozenberg. <u>Results of Third All-Union Symposium on combustion and explosions.</u> FGiV, no. 4, 1971, 616-618.

The Symposium, which took place July 5-10, 1971 in Leningrad, was attended by 730 representatives from 210 organizations. There were three sections: on combustion, detonation, and kinetics. Three plenary reports and 154 section reports were presented. The plenary sessions reports were presented by Ya. B. Zel'dovich, (The contribution of D. A. Frank-Kamenetskiy to the theory of combustion), V. V. Pomerantsev (Atomization, evaporation, and combustion of liquid fuel), and A. D. Margolin (The present status and some problems of the combustion theory of condensed systems).

At the section on combustion, 79 reports were presented in 9 subject areas: ignition in condensed systems, steady combustion of condensed systems, combustion stability and non-steady combustion of condensed systems, combustion in dispersion systems, flame propagation limits in gases, laminar combustion of gases, combustion of organic fuels, turbulent combustion of gases, and combustion in supersonic flow. The problem of supersonic combustion was included for the first time in the program of the All-Union Symposiums.

At the section on detonation, 36 reports were presented in 4 subject areas: detonation of condensed explosives, detonation in gaseous and heterogeneous systems, sensitivity of explosives to mechanical interactions, and physico-chemical transformations of materials from shock wave effects. In addition to reports on the continuation of theoretical and experimental research on shock wave propagation in condensed media, other reports in this section dealt with

the mechanism of physicochemical processes under conditions of shock compression, monomer polymerization, diffusion in a shock-wave front, and polarization of metals and dielectrics. An increasing number of papers discussed precise physical methods for directly observing the property changes of substances under conditions of shock compression.

At the section on kinetics, 39 reports were presented in 8 subject areas: chain reaction kinetics, gas-phase kinetics, elementary processes, kinetics of high temperature processes in shock tubes, kinetics of the thermal decomposition of ammonium perchloride, kinetics of thermal decomposition reactions, kinetic reactions in flames and combustion thermodynamic processes. A. S. Biryukov, A. P. Dronov, Ye. M. Kudryavtsev, G. A. Raynin, and N. N. Sobolev reported on a shock tube investigation of a CO_2 laser.

Bobolev, V. K., I. A. Karpukhin, and V. A. Teselkin. Mechanism excitation by impact in ammonium perchlorate mixtures with combustible additives. FGiV, no. 2, 1971, 261-264.

It was shown by Afanas'yev et al (FGiV, no. 4, 1968, 4) that ammonium perchlorate (APC) has the impact properties of a conventional explosive, while also manifesting high chemical activity as an oxidizer. Experiments which take both these features into account were carried out to ascertain the influence of chemical interaction of the decomposition products of APC with the combustible components on the process of percussive explosion. APC + TNT, APC + PMMA, and other mixtures were studied. The critical explosion-activation pressure $\overline{P}_{cr}$ of APC mixtures with combustible components relationship to the composition, and to the crystal size of the oxidizer was investigated. The experimental data are

presented in Fig. 1. Comparison of the relationships in Fig. 1 with

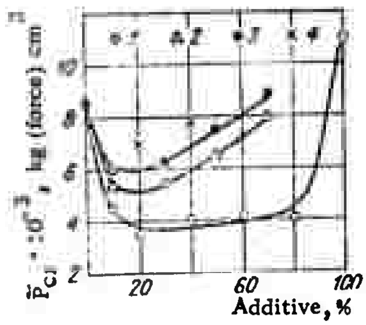


Fig. 1. Composition relationship of $\overline{P}_{cr}$ of mixtures of APC with TNT (1), PMMA (2) - APC particle size 250-315μ, (3)-10μ, and ammonium nitrate (4).

analogous ones for binary explosives + explosive mixtures suggests an essential change in the explosion activation by percussion, possibly due to the effect of chemical interaction of the decomposition products of the oxidant and the fuel in the reaction foci. The thermal decomposition of APC commences with imperfections of the crystal structure. The more imperfect the APC crystals and the higher the content of various admixtures, the more intense is the APC decomposition in the initial, low-temperature stage. In mixtures with the same composition, $\overline{P}_{cr}$ assumes lower values for APC of larger grain size (see Fig. 1). A comparison of experimental data on the relationships of PMMA and APC mixtures with a 250-315μ and 4μ particle size to the composition shows that the use of APC with less imperfect particles essentially impairs the conditions of explosion activation by impact, thereby raising the values of $\overline{P}_{cr}$. The results can apparently be applied to other oxidant + combustible additive systems in which thermal decomposition of the oxidant proceeds in several stages, particularly for ammonium nitrate mixtures with combustible additives.

Zakharenko, I. D. Thermal conditions of a welded-seam zone during explosive welding. FGiV, no. 2, 1971, 269-272.

A procedure is described for measuring the temperature in the welding zone and the thermal conditions of the welded metals are calculated. The temperature is measured by the method of natural thermocouples, formed directly by the welded plates in a measuring device. The measurements are recorded on an oscillograph. The procedure makes it possible to determine the welded seam temperature as well as the quantity of heat released in the weld. On the basis of an equation of thermal conductivity, a formula is provided for calculating the temperature of specimen cross sections.

Chagelishvili, E. Sh. Explosion strengthening of a hard cermet alloy. FGiV, no. 2, 1971, 275-280.

A procedure is described for increasing the hardness of a WC-Co hard cermet alloy by explosive loading. It is shown that increased strength, density, hardness, and other properties of the industrially hard alloy in the ordinary state can be obtained by explosive strengthening. Diagrams are given showing the shock loading techniques, and photos are included showing the strengthening effect on crystal structure.

Dubovik, A. V., and V. K. Bobolev.
Cavity mechanism of explosion initiation in a liquid layer under shock.
FGiV, no. 2, 1971, 245-253.

The factors governing the collapse of cylindrical cavities in a nitroglycerin layer upon impact were investigated. A relationship was experimentally established between the velocities of the boundaries of collapsing cavities and those of the cumulative jets. Attention is devoted to gas heating within a cavity, and the role of liquid microjets. The necessary conditions for the initiation of an explosion as a result of jet impact are discussed. The primary conditions are: 1) a sufficiently high gas temperature within the cavity, and 2) an adequate explosive particle residence time in the heated gas to initiate the reaction.

Dubovik, A. V., and V. K. Bobolev.
Factors governing explosion excitation in nitroglycerine during the shock collapse of air cavities. FGiV, no. 2, 1971, 253-260.

Based on an analysis of the pattern of gas cavities collapse in a liquid explosive layer, a possible mechanism for the shock initiation of an explosion was formulated by the authors in the preceeding article. Continuation of the chemical reaction initiated depends on the nature of the heat release within the cavity and the status of the cavity surface at the reaction moment of time. Assuming Ω_1 is the particle volume and Ω_2 is the cavity volume, the temperature value T_O established in the compressed cavity from the injection of explosive particles with an initial temperature T_1 is given by

$$T_0 = T_2 \frac{1 + \rho_1 c_1 \Omega_1 T_1 / \rho_2 c_2 \Omega_2 T_2}{1 + \rho_1 c_1 \Omega_1 / \rho_2 c_2 \Omega_2},$$

where T_2 is the cavity gas temperature prior to particle injection; ρ is the density; and c is the specific heat; ($_1$ refers to the liquid, and $_2$ to the gas).

A qualitative explanation is given for explosion excitation patterns in nitroglycerine, and an analysis is made of the frequency curves obtained during the investigation. The nature of the curves indicates that at fixed dimensions of the nitroglycerine layer and for given load rates, optimal cavity dimensions exist, the collapse of which initiates explosions. The effect of gelatinization on explosion initiation in nitroglycerine is also discussed.

Vovk, A. A., and A. V. Mikhalyuk. Wave process characteristics in a ground mass during explosions by air-casing charges. ZhPMTF, no. 2, 1972, 105-110.

A study of the wave process characteristics in a ground mass during explosions by air-casing charges was conducted with concentrated confined charges (charge weight 0.2 kg) and linearly distributed ejection charges (4 kg of explosive per meter) in loam with a density of 1990 kg/m^3 and an average moisture content of 14.17% by weight. The effect of the charge air-casing size on the parameters of detonation waves propagating in the ground during the explosion was investigated. The explosive used in all experiments was pressed trotyl with a density of 1600 kg/m^3, a detonation rate of 6 km/sec, and a specific intrinsic energy of 1010 kcal/kg. The charge was placed in a cardboard case, with a volume exceeding the charge volume by the air casing size. The stress wave parameters were measured by a tensometric complex. Sensors were installed to permit registration of the radial σ_r, axial σ_z, and circumferential σ_q components of the stress tensor.

An analysis of the experimental results shows that when the volume of the air casings is close to optimal, an increase of the detonation impulse time in the low-pressure region occurs. This is particularly evident in explosions of linearly distributed charges. Scattering of the experimental point data precluded the drawing of conclusions on the explosions of the concentrated confined charges. Changes in stress wave parameters during the explosion of air-casing charges affect the distribution of pressure impulse values. The redistribution of the deformation energy due to changes in the charge design was confirmed by experimentally established relationships on the change with distance of the radial impulse values on the load sector at various relative volumes of the air casings during explosions of centrally-symmetric and axisymmetric charges.

It is shown that the air casing of a charge has a significant effect on practically all the parameters of a wave disturbance propagating in the ground from an explosion. The characteristic wave processes in ground masses from explosions by air-casing charges can be used for calculating explosion effects when cutting through mine workings and other underground structures in compressible soil.

Inogamov, I. I., and F. N. Pys'.
Destruction mechanism of rocks from explosions. IAN UzSSR. Ser. tekh. nauk, no. 3, 1972, 77-80.

Soviet research on the mechanism of rock destruction by explosive action is surveyed. Vlasov et al (IAN SSSR, 1962) showed that an approximate solution of explosion problems can be obtained by assuming that transmission of the explosion energy to the surrounding medium is instantaneous, and that the medium is incompressible. Principles were developed on this basis for the calculation of rock fragmentation by an explosion. The granulometric composition of the blown-up rock mass can consequently be theoretically determined by classical mechanics, and the fragmentation action of cylindrical charges can be calculated. However, the only changes and deformations taking place in the medium which can be evaluated using this model of the rock-fragmentation process, are the end results of explosive action.

Sukhanov (IN: Sbornik. Voprosy teorii razrusheniya gornykh porod vzryva. IAN SSSR, 1958) proposed a formula for taking into account the resistance of rock to separation along the lateral surface of the explosion funnel, and the passage of the gravitational forces of the rock within the funnel. Khanukayev suggested (IN: Energiya voln

napryazheniy pri razrushenii prod vzryvom, Gosgortekhizdat, 1962) that rocks be divided into three groups based on the physicomechanical properties and manner of occurrence of the destruction process (by low, medium and high acoustic rigidity). Mosinets (IAN KirgSSR, 1963) established that 75-80% of the total destruction is created in advance by stress waves propagating in the rock mass, and it is completed by the piston action of the gaseous explosion products. According to Drukovskiy and Komir (IN: Sbornik. Vzryvnoye delo, 1965) the mechanism of rock destruction from an explosion is determined by the value and duration of the explosive impulse. Mel'nikov and Marchenko (IGO AN SSSR, 1959) proposed a method for decreasing the explosion energy loss by using charges dispersed lengthwise by air intervals.

The mechanism of the action of Ignadit was reported on by Demidyuk (IN: Sbornik. Vzryvnoye delo, no. 45, 1960). The authors note in conclusion that a large number of differing and in some cases contradictory theories have been presented on explosive effects in rocks, and remain to be reconciled.

Benediktov, Ye. A., G. V. Bukin, Yu. V. Kushnevskiy, S. N. Matyugin, N. P. Mozerov, Yu. K. Perekhvatov, and M. D. Fligel'. Reception of Kosmos-381 signals from a conjugate point region. Kosmicheskiye issledovaniye, no. 2, 1972, 302-303.

An attempt is described to detect satellite r-f signals from a conjugate point, with the object of precluding the possible anomalous magnetospheric or ionospheric modes that may be excited from ground-based transmitters in conjugate point experiments. The tests were done in December, 1970 using the Kosmos-381 satellite which broadcast at 2, 3.2, 5.6, 8.6, 10.4 and 12.8 MHz. Pulse power was 100w, and pulse width was 150μs at a 48 Hz repetition rate; reception was monitored with wideband delta or rhombic arrays at both the Moscow and Gor'kiy tracking stations. During part of the test period the orbital plane included both the receiver and conjugate points; the remaining orbits included the conjugate point only.

In the 13th recording session with transmission at 12.8 MHz, a signal from the conjugate point (lat. 39.5° S, long. 55° E) was clearly received at Moscow for an interval of 20 seconds, corresponding to a satellite travel of 150 km. The magnetosphere channel width was however somewhat less than this value, since the satellite path was presumably at some inclination to it, and also because the channel tends to "trap" the transmitted signal near its boundaries. Analogous reception at Gor'kiy was only for 0.25 to 0.5 sec, evidently because the satellite only grazed the waveguide channel. In some cases conjugate point reception was obscured by noise in the 12.8 MHz range; however there were cases where clear line-of-sight signals were recorded with no corresponding conjugate point reception.

Since the tests were conducted at various times of day and orbital inclinations, the authors point out that their data indicate the spatial and time variation in the magnetosphere channel.

Krupina, A. Ye. Effect of collisions on propagation of plasma waves near a harmonic of the electron gyrofrequency. IVUZ Radiofiz, no. 4, 1972, 517-520.

A brief treatment is given to certain conditions encountered in propagation of a high frequency wave in plasma, perpendicular to an external magnetic field. In view of experimental evidence of resonance effects in upper ionosphere probes, the author considers the factors governing propagation of a wave at $\omega \cong n\,\omega_H$, where ω_H is electron gyrofrequency and n is an integer. In particular the dissipative effects occurring in this range are taken into account, under the assumption that the transmitted wavelength is substantially greater than electron gyroradius. In addition to relativistic effects, the analysis considers collision of electrons with other particles. The derived dispersion equation is analyzed for specific cases of weak and strong collisions, and is also related to detuning of the resonant point.

Benediktov, Ye. A., L. V. Grishkevich, and V. I. Ivanov. Simultaneous measurement of electron concentration and collision frequency in the ionospheric D-region, using a partial reflections method. IVUZ Radiofiz, no. 5, 1972, 695-702.

In a related earlier work the authors described initial results in measuring electron density N in the D-layer by obtaining the correlation coefficient between backscatter of the ordinary and extraordinary wave components (IVUZ Radiofiz, no. 9, 1971, 1452). In that paper the feasibility of simultaneously determining the collision frequency ν_m from the same data was postulated; in the present article this is verified theoretically and experimentally. The analysis assumes a rectangular transmitted pulse τ at frequency ω and a sufficiently directional beam so that, neglecting absorption in the scattering medium, the correlation coefficient for both wave components may be found from

$$\rho_{A_0 A_x} = \frac{\sin^2 X}{X^2}, \qquad (1)$$

where $X = kL(\mu_0 - \mu_x)$; μ_0 and μ_x are refractive indices of the ordinary and extraordinary components; $L = c\tau/2$; and $k = \omega/c$.

Graphical results of ρ (N) are presented for an assumed set of ν_m, based on Eq. (1), and calculated for transmitted frequencies of 3 and 5.75 MHz. It is shown that with the assumed simplifications the error in calculated N should not exceed 15 to 25% for $0.1 < \rho < 0.95$. Using the same model the authors arrive at theoretical values of $\nu_m(h)$ which are claimed to be accurate within 15--30%.

Test data confirming the foregoing were obtained in 1969-70 from vertical probes at 5.75 MHz and $\tau = 50\mu s$, with a $12^\circ \times 12^\circ$ directional pattern at medium latitudes. Further extensive tests were made at Gor'kiy in 1970 and are to be treated in a subsequent paper.

Mironov, V. L., and S. S. Khmelevtsov.
Laser beam divergence during propagation in a turbulent atmosphere along an oblique path. IVUZ Radiofiz, no. 5, 1972, 743-750.

The authors develop expressions which define the turbulence broadening effect on laser propagation in the atmosphere. The general case of an inclined path is treated, requiring that different turbulence characteristics of specific altitude ranges be taken into account. The argument is given in terms of the function $C_n^2(x')$ which is defined as the structural characteristic of refractive index variation over a path length x'. Since this variation has been found to be a function of extended convection, it is convenient to examine C_n^2 directly as a function of altitude h, after the manner proposed by Tatarskiy. Thus for the dynamic boundary layer ($h < 50$ m) this characteristic is given by

$$C_n^2(h) = C_n^2(h_0)(h/h_0)^{-2/3}, \qquad (1)$$

where h_0 is some arbitrary transmitter height. At higher altitudes where free convection applies ($h \cong 1$ to 3 km), the relation alters to

$$C_n^2(h) = C_n^2(h_0')(h/h_0')^{-4/3}, \qquad (2)$$

where $h_0' = 50$ m. For $h > 3$ km, it becomes

$$C_n^2(h) = C_n^2(h_0')(h/h_0')^{4/3}\exp\left(\frac{h_0' - h}{h_0''}\right), \qquad (3)$$

where $h_0'' = 10$ km, the thickness of the optically active atmospheric layer.

Using the foregoing expressions for $C_n^2(h)$ in a dimensionless fashion, the authors compare their calculated results with those of several other authors for altitudes up to about 10 km; those results are given graphically. A further analysis shows that less turbulence

broadening is suffered when transmitting downward than upward through the atmosphere; this however is not contradictory if the finite dimensions of the transmitter aperture are considered, rather than the point source assumed in the theoretical calculations. It is also shown that for downward propagation, the maximum turbulence scattering will consistently occur at the same transmitter altitude; the authors' data put this at approximately 2 km.

Kuz'micheva, A. Ye., L. I. Dorman, and N. S. Kaminer. Determination of shock wave velocity in an interplanetary medium. Geomagnetizm i aeronomiya, no. 3, 1972, 534-535.

Based on previous work of the authors and others, additional observations are given on shock wave velocity in the interplanetary medium between the Venus-6 spacecraft and Earth. Data on shock wave formation events of March 23 and May 14, 1969 are diagrammed and tabulated. Shock wave velocity in the Venus-6-Earth segment increased (by ~34%) during the May 14th event, but decreased during the March 23rd event. Results show that for an accurate determination of the nature of shock wave propagation it is vital to consider that spherical shock waves originate at an appreciable distance from the sun. This is particularly important for those cases when the heliocoordinate difference of a chromospheric flare and the earth is large.

Tsaplin, V. S. and L. V. Zubareva. Transient and spatial intensity distribution of excess radiation in the vicinity of the equator. GiA, no. 3, 1972, 536-537.

Satellites of the Kosmos series were launched from July 1965 through March 1969, into orbits with apogees of about 350 km, perigees of about 200 km, and a 65° inclination to the equatorial plane, i.e. such that over 80% of the time the satellites were well below the radiation belts of the earth. A gasdischarge counter installed on each spacecraft registered on the basis of a direct passage, electrons with an energy of $E_e > 8$ Mev and protons with an energy of $E_p \gtrsim 60$ Mev. The intensity of the recorded radiation in the vicinity of the equator was ~ 0.6 particles $cm^{-2} sec^{-1}$, which exceeds a previously recorded count of the primary cosmic-ray component in this region by an order of magnitude.

The stability of the intensity of this excess radiation corresponds to the stability of primary cosmic radiation. On this basis a curve was constructed of the intensity minima of excess radiation in terms of geographic coordinates (Fig. 1).

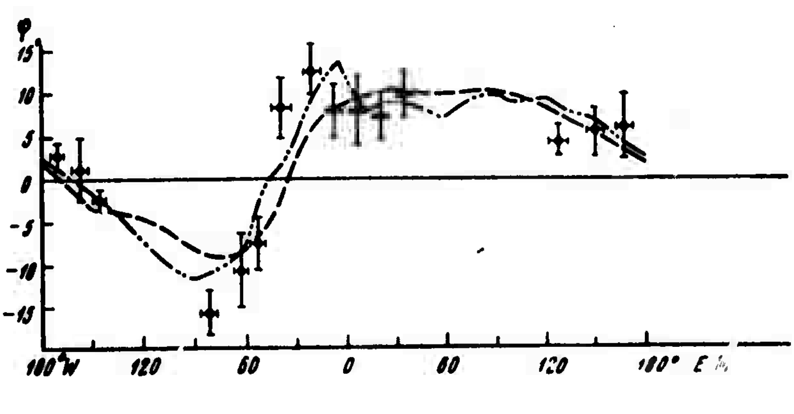


Fig. 1. Intensity minima of excess radiation.

The experimental values obtained by this method coincide well with the position of the cosmic-ray equator calculated by Kellog and Schwartz in an octupole approximation(point-dash line) and by Quenby and Webber with account taken of the nondipole part of the geomagnetic field (dashes). This suggests that the excess radiation is a secondary component, generated by cosmic-ray particles in the Earth's atmosphere and the housing of the unit. A relatively large mean-square error value is apparently explained by the statistical relationship of the secondary component multiplicity to the primary particle energy, and the influence of the Earth's magnetic field on the trajectory of the excess-radiation particles.

Katasev, L. A. and V. F. Chepura.
Investigation of movement of artificially ionized clouds in the upper atmosphere.
GiA, no. 3, 1972, 473-476.

Results are presented of simultaneous observations of the movement of artifical ionized and noctilucent clouds in the ionosphere. Measurements were made of 1) the velocity of ionized clouds on the basis of the Doppler effect reflected signals and 2) wind-velocity values, obtained in the same experiments using artificial noctilucent clouds.

The phase change of signals reflected from the ionized clouds was studied by two laser DME units operating at f = 24 MHz, which recorded the Doppler signal shifts on photographic film. Noctilucent clouds were photographed at two points by two aerial cameras. Ionized and noctilucent clouds were simultaneously formed by ejecting atomic

cesium and sodium from a single container. Points for observation of the ionized clouds were situated virtually along the line of projection to the Earth of the point of cloud formation so that the Doppler-frequency phase shift of signals reflected from the clouds determined primarily by the movement of the clouds would differ little from one another at the observation points. A large difference of Doppler frequencies at the observation points during the experiment and, consequently, of cloud velocities, would testify to an essential influence of the space-time instability of the cloud structure on the phase change of the signals reflected from the cloud.

Two experiments were conducted over Volgograd in 1969. Ionized and noctilucent clouds were created on October 14, at 0523 hours local time, at an altitude of 120 km, and on October 22, at 0533 h at an altitude of 116 km. In contrast to the results of Gallacher and Barnes (J. Geophys. Res., v. 68, 1963, 2987), the radial velocity of the ionized cloud at observation points P1 and P2 remained relatively stable. A statistical analysis of the experimental data shows that scattering of the radial velocity values of the ionized clouds at each observation point is principally governed by a normal distribution law.

The comparative values of radial velocity of the ionized clouds and the mean-square deviations at both observation points differ little. Due to the relatively large distance between the observation points, no correlation was made of the instantaneous phase changes of the field of the wave reflected from the ionized cloud. It is concluded that the wave phase changes reflected from the cloud and averaged over 0.5-second observation intervals, are determined principally by the cloud movement. This is supported by a comparison of the values of the velocity of the noctilucent cloud (coinciding with the wind velocity and averaged for the

time of each experiment) with those of the ionized cloud. In both experiments, the difference between the velocity of the ionized cloud and the wind velocity is within the limits of experimental error.

The results of the experiments show that the phase changes of a wave reflected from an ionized cloud, even when averaged at 0.5-second observation intervals, are determined primarily by the cloud movement. Phase methods can therefore be used for investigating the movement of ionized clouds in the upper layer of the atmosphere. The results of Gallacher and Barnes, referred to above, are apparently explained by an inadequacy of the method for measuring the signal Doppler phase shift as reflected from the ionized clouds.

Pridatchenko, Yu. V., and Yu. I. Shmakov.
Rheological equations of state for weak polymer solutions with rigid ellipsoidal macromolecules.
ZhPMTF, no. 2, 1972, 125-129.

Results obtained by Shmakov and Taran (I-FZh, v. 18, no. 6, 1970) are generalized by taking macromolecular inertia and the effects of external electric and magnetic force fields into account when deriving rheological equations of state for weak polymer solutions with rigid ellipsoidal macromolecules and macromolecular Brownian motion. The effects of macromolecular inertia on the rheological properties of liquids are analyzed. Using Jeffery's expressions for flow perturbation caused by a suspended rigid ellipsoid in a viscous Newtonian fluid, the authors derive equations for the stressed state of liquid. From these, eight rheological constants are determined for equations describing the isothermal motion of an incompressible anisotropic fluid with a constant magnitude structural orientation vector. The ninth rheological constant is found by considering a special case (the absence of external force fields and a negligibly small particle inertia). Rheological equations of state are found by averaging Ericksen's tension tensors over the angular distribution function for the axis of rotation of an elliptical particle, and making use of the rheological constants. As an example, the Couette flow of a polymer solution with rigid ellipsoidal macromolecules in the absence of external force fields and rotational Brownian motion is analyzed. It is found that, in the presence of macromolecular inertia with or without macromolecular Brownian motion, weak polymer solutions of molecules, approximated by a rigid ellipsoid of rotation will exhibit non-Newtonian properties.

Zhdanov, V. A., and V. F. Konusov.
On the theory of an equation of state for solids. IN: Itogi issledovaniy po fizike, 1917-1967. Tomsk. Tomskiy universitet, 1971, 87-102. (RZhKh, 10/72, no. 10B577)

Consideration is given to the general properties of equations of state derived in terms of quasi-harmonic approximations of crystal lattices under the effect of mechanical stresses of an arbitrary type. The influence of lattice symmetry on the form of the equations of state is clarified, as well as that of the binding forces. A study is made of the critical states of crystal lattices prior to mechanical failure. Results of research on a series of specific crystals are discussed.

B. Recent Selections

i. Shock Wave Effects

Buzhinskiy, O. I., and L. P. Volkov. Investigation of electromagnetic shock tube excited shock waves. ZhTF, no. 8, 1972, 1733-1739.

Czerniawski, B., M. Golinska, and A. Nassalski. Impact strength tests of polyethylene foil. Opakowanie, v. 18, no. 1, 1972, 5-8. (RZhMekh, 7/72, no. 7V1113)

Deribas, A. A., A. N. Kiselev, G. Ye. Kuz'min, and E. Sh. Chagelishvili. Shock wave interaction with cermets. IN: Sbornik. Dinamika sploshnoy sredy, Novosibirsk, no. 8, 1971, 103-117. (RZhMekh, 7/72, no. 7B231)

Glaznev, V. N., and N. A. Zheltukhin. Shock reflection of acoustic waves in a variable cross section channel. IAN SO SSSR, Ser. tekhn. nauk, no. 2, 1972, 61-66.

Kalashnikov, N. G., L. V. Kuleshova, and M. N. Pavlovskiy. Shock compression of polyethylene tetrafluoride at approximately 1.7 mbar. ZhPMTF, no. 4, 1972, 187-191.

Kartalev, M. D. Cemplen theorem for plasma shock waves with anisotropic pressure. DAN SSSR, v. 205, no. 6, 1972, 1316-1319.

Malyy, V. I. Long wave approximation in problems of stability loss from shock. MTT, no. 4, 1972, 138-144.

Mamedov, G. A. Stress-deformation dependence under lateral impact. IAN Az, Ser. fiz.-tekh. i mat. nauk, no. 1, 1972, 21-24.

Maykapar, G. I. Calculation of body resistance from bow shock wave shape. IN: Uchenyye zapiski TsAGI, v. 2, no. 6, 1971, 23-31. (RZhRaketostroyeniye, 4/72, no. 4.41.138)

Mitrofanov, V. V., and V. A. Subbotin. Averaged pressure profile of a multifrontal detonation wave in gas mixtures. IN: Sbornik. Dinamika sploshnoy sredy, Novosibirsk, no. 9, 1971, 140-145. (RZhMekh, 7/72, no. 7B238)

Ostapenko, V. A., and O. V. Yavtushenko. Modelling of shock pulse formation under time-controlled collision. IN: Sbornik. Voprosy prochnosti, nadezhnosti i razrushenii mekhanicheskikh sistem, Dnepropetrovsk, 1969, 251-259. (RZhMekh, 7/72, no. 7V124)

Polyanskiy, O. Yu. Structural characteristics of weak shock waves in a relaxing gas. IN: Uchenyye zapiski TsAGI, v. 2, no. 6, 1971, 55-61. (RZhMekh, 7/72, no. 7B224)

Rusov, B. P. Interrelationships of methods for measuring shock resistance of plastics. IN: Trudy Sibirskogo NII metrologii, no. 13, 1971, 122-126. (RZhMekh, 7/72, no. 7V1105)

Semiletenko, B. G., and V. N. Uskov. Experimental relationships governing jet shock wave location flowing perpendicular to the axis of an obstacle. I-FZh, v. 23, no. 3, 1972, 453-458.

Stoimenov, L. G. Experimental results on impact of rough bodies under slip. PM, no. 8, 1972, 116-120.

Yakushev, V. V. Nonuniformity of dynamic loading of a specimen in shock compression polarization tests of dielectrics. ZhPMTF, no. 4, 1972, 155-161.

Yershov, A. P., P. I. Zubkov, and L. A. Luk'yanchikov. Measuring conduction zone width behind a detonation front in PETN. IN: Sbornik. Dinamika sploshnoy sredy, Novosibirsk, no. 8, 1971, 177-182. (RZhMekh, 7/72, no. 7B240)

Zevin, A. A. Induced oscillations on a shock carrier plate. IN: Trudy TsNII stroitel'nykh konstruktsiy imeni V. A. Kucherenko, no. 17, 1971, 209-226. (LZhS, 32/72, no. 106030)

Zlatin, N. A., and B. S. Ioffe. Time dependence of separation resistance to cleavage. ZhTF, no. 8, 1972, 1740-1744.

ii. Hypersonic Flow

Abramovich, G. N., V. B. Kuz'mich, A. N. Sekundov, and I. P. Smirnova. Experimental and theoretical investigation of supersonic jet boundary in supersonic wake flow. MZhiG, no. 4, 1972, 25-32.

Akylbayev, Zh. S., S. I. Isatayev, and V. V. Polzik. Vortex breakdown from an inadequate aerodynamic body and effect on heat transfer. IN: Sbornik. Teplo- i massoperenos, v. 1, Minsk, 1972, 291-295. (RZhMekh, 7/72, no. 7B733)

Andreyev, G. N., and Yu. D. Shevelev. Supersonic three-dimensional boundary layer on a segmented body. IN: Trudy Sektsii po chislovym metodam v gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, v. 1, 1969. Moskva, 1971, 227-246. (RZhMekh, 7/72, no. 7B677)

Ankudinov, A. L. Calculation of a hypersonic viscous shock layer with foreign gas supply at moderately low Reynolds numbers. IN: Trudy TsAGI, no. 1315, 1971, 40-60. (LZhS, 32/72, no. 105037)

Ankudinov, A. L. A transform for the equation of a viscoelastic layer. IN: Trudy TsAGI, no. 1315, 1971, 34-39. (LZhS, 32/72, no. 105038)

Ankudinov, A. L. Foreign gas injection in a hypersonic viscous shock layer. MZhiG, no. 4, 1972, 110-116.

Belotserkovskiy, O. M., and V. N. Fomin. Supersonic flow around blunt bodies by a radiative gas stream. IN: Trudy Sektsii po chislovym metodam v gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagirushchikh sistem, v. 3, 1969. Moskva, 1971, 154-178. (RZhRaketostroyeniye, 4/72, no. 4.41.152)

Bogdanovskiy, G. A., B. Ye. Zhestkov, and A. V. Lipin. Diagnostics of high temperature rarefied gas flow. IN: Sbornik. Teplo- i massoperenos, v. 1, part 3, Minsk, 1972, 204-208. (RZhMekh, 7/72, no. 7B281)

Bondarev, Ye. N., and G. A. Gushchin. Three-dimensional interaction of jets propagating in supersonic wake flow. MZhiG, no. 4, 1972, 170.

Borisov, S. F., B. T. Porodnov, and P. Ye. Suyetin. Mass transfer for gas interaction with a streamlined surface. IN: Sbornik. Teplo- i massoperenos, v. 1, Minsk, 1972, 250-253. (RZhMekh, 7/72, no. 7B731)

Chesna, B. A., Yu. K. Stasyulyavichyus, and V. Yu. Survila. Surface friction interrelationship with heat transfer of a longitudinally-streamlined cylinder. IN: Sbornik. Teplo- i massoperenos, v. 1, Minsk, 1972, 301-306. (RZhMekh, 7/72, no. 7B734)

Finat'yev, Yu. P., L. A. Shcherbakov, and V. T. Filin. Gas dynamic structure and electron distribution in a high temperature supersonic jet with a solid phase. IN: Sbornik. Teplo- i massoperenos, v. 1, Minsk, 1972, 227-231. (RZhMekh, 7/72, no. 7B118)

Gusev, V. N., Yu. V. Nikol'skiy, and L. G. Chernikova. Heat transfer during hypersonic rarefied gas flow around a body. IN: Sbornik. Teplo- i massoperenos, v. 1, Minsk, 1972, 254-262. (RZhMekh, 7/72, no. 7B732)

Karasev, A. B., T. V. Kondranin, and A. N. Lyakh. Effect of uncertainty in the understanding of thermodynamic and transport properties of high temperature gases on radiative heat transfer. IN: Sbornik. Teplo- i massoperenos, v. 1, part 3, Minsk, 1972, 284-290. (RZhMekh, 7/72, no. 7B767)

Kharchenko, V. N. Flow and heat transfer during coolant injection in supersonic flow. IN: Sbornik. Teplo- i massoperenos, v. 1, Minsk, 1972, 296-300. (RZhMekh, 7/72, no. 7B751)

Kondrya, A. K., and N. V. Leont'yeva. Hypersonic nonequilibrium-ionized gas flow around blunt bodies taking leading radiation into account. ZhPMTF, no. 4, 1972, 179-182.

Kovalenko, V. M., N. I. Nesterovich, and V. M. Shulemovich. Experimental investigation of turbulent boundary layer of a large elongation body of revolution in supersonic flow. IAN SO SSSR, Ser. tekh. nauk, no. 2, 1972, 41-46.

Mavlyudov, S. V. Coefficient of particle precipitation on a wedge in supersonic flow of a two-phase mixture. IN: Sbornik. Voprosy vychislitel'noy i prikladnoy matematiki, no. 10, Tashkent, 1972, 165-169. (RZhMekh, 7/72, no. 7B1027)

Mirzoyev, I. M. Calculation of an axisymmetric supersonic gas jet flowing in a supersonic wake around a body with heat supply. IAN Az, Ser. fiz.-tekh. i mat. nauk, no. 1, 1972, 17-20.

Molodtsov, V. K., and A. N. Tolstykh. Calculation of hypersonic viscous flow around blunt bodies. IN: Trudy Sektsii po chislovym metodam v gazovoy dinamike 2-go Mezhduanrodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, v. 1, 1969. Moskva, 1971, 37-54. (RZhRaketostroyeniye, 4/72, no. 4.41.153)

Myshenkov, V. I. Numerical solution of Navier-Stokes equations for the problem of gas flow around a rectangle. MZhiG, no. 4, 1972, 10-17.

Rusanov, V. V. Types of supersonic gas flow around a single class of blunt bodies. MZhiG, no. 4, 1972, 170.

Shifrin, E. G. Problem of supersonic equilibrium flow around a profile. MZhiG, no. 4, 1972, 162-165.

Tiganov, Ye. V. Light scattering investigation of longitudinal and transverse hypersonic wave propagation in liquids. IN: Trudy Fizicheskogo instituta imeni Lebedeva, v. 58, 1972, 42-79. (LZhS, 36/72, no. 119100)

Vezmenov, V. Ya., and P. I. Gorenbukh. Application of an unstable analogy to the study of the effects of an explosion wave on a barrier in a hypersonic tube. IN: Uchenyye zapiski TsAGI, v. 2, no. 6, 1971, 48-54. (RZhRaketostroyeniye, 4/72, no. 4.41.157)

Vlasov, V. I. Calculation of aerodynamic characteristics of an infinite span in hypersonic rarefied gas flow. IN: Uchenyye zapiski TsAGI, v. 2, no. 6, 1971, 116-118. (RZhRaketostroyeniye, 4/72, no. 4.41.141)

Zamurayev, V. P. Heat transfer to blunt bodies at high speeds and altitudes. IN: Sbornik. Teplo- i massoperenos, v. 1, Minsk, 1972, 162-166. (RZhMekh, 7/72, no. 7B730)

Zhukauskas, A. A., V. I. Makaryavichyus, and A. T. Shakmanas. Heat transfer under transverse flow around a cylinder by dissociative combustion products of a propane-oxygen mixture. IN: Sbornik. Teplo- i massoperenos, v. 1, Minsk, 1972, 271-276. (RZhMekh, 7/72, no. 7B735)

iii. Soil Mechanics

Koptev, V. I., A. I. Savich, A. M. Zamakhayev, and T. A. Voronkova. Seismo-acoustic investigation of stress state in a rock mass. IN: Sbornik. Tezisy IV Konferentsii izyskatel'nogo instituta Gidroproyekt po obmenu opytom izyskaniy dlya gidrotekhnicheskogo stroitel'stva, 1972, Sektsiya inzhenernoy geologii, no. 2, 1972, 33-34. (RZhMekh, 7/72, no. 7V675)

Korenev, B. G., and L. M. Reznikov. Damping of tower vibrations from seismic disturbances. IN: Stroitel'naya mekhanika i raschet sooruzheniy, Podol'sk, no. 5, 1971, 1-5.

Malyshev, L. K., L. V. Shevikova, and S. G. Shul'man. Theoretical and experimental investigations of canyon rim oscillations from seismic effects. IN: Izvestiya VNII gidrotekhn., no. 98, 1972, 19-33, 182. (RZhMekh, 7/72, no. 7V673)

Mikhaylov, A. D., E. A. Grigor'yants, L. D. Lavrova, and A. A. Gorbunov. Geophysical investigations of decompaction zones in hydroelectric power plant excavations. IN: Sbornik. Tezisy IV Konferentsii izyskatel'nogo instituta Gidroproyekt po obmenu opytom izyskaniy dlya gidrotekhnicheskogo stroitel'stva, 1972, Sektsiya inzhenernoy geologii, no. 2, 1972, 53-54. (RZhMekh, 7/72, no. 7V676)

Mikhaylova, A. V. Innovations in methods for evaluating deformation models. IN: Sbornik. Tektonika Sibiri. Moskva, Izd-vo Nauka, v. 5, 1972, 192-196. (RZhMekh, 7/72, no. 7V686)

Mikhaylovskiy, G. V. Test application of seismic surveying during geological engineering surveys in regions of permafrost expansion. IN: Tezisy IV Konferentsii izyskatel'nogo instituta Gidroproyekt po obmenu opytom izyskaniy dlya gidrotekhnicheskogo stroitel'stva, 1972, Sektsiya inzhenernoy geologii, no. 2, 1972, 79-81. (RZhMekh, 7/72, no. 7V674)

Narozhnaya, Z. V., and G. V. Rykov. Errors in stress measurements in soils under short duration loads. ZhPMTF, no. 4, 1972, 148-154.

Stavnitser, L. R., and O. Ya. Shekhter. Forced horizontal oscillations of piles under seismic wave effects. Osnovaniya, fundamenty i mekhanika gruntov, no. 5, 1971, 17-23.

Strel'chuk, N. A., O. K. Slavin, and V. N. Shaposhnikov. Modelling of stress wave diffraction processes of various obstructions in a continuous medium. IN: Fiz.-tekhn. problemy razrabotki poleznykh iskopayemykh, no. 6, 1971, 28-38. (LZhS, 33/72, no. 109481)

Vovk, A. A., G. I. Chernyy, and A. V. Mikhalyuk. Problems in rock deformation from large scale explosions. PM, no. 8, 1972, 90-95.

iv. Exploding Wire

Lebedev, S. V., A. I. Savvatimskiy, and Yu. B. Smirnov. Electrical explosion method and measurement of heat of fusion and electrical conductivity of refractory metals. ZhTF, no. 8, 1972, 1752-1760.

v. Equations of State

Avdeyeva, G. M., and A. A. Midgal. Equation of state in a (4 - ϵ)-dimensional Ising model. ZhETF P, v. 16, no. 4, 1972, 253-255.

Chaykovskiy, V. F., V. I. Los', G. K. Lavrenchenko, and L. V. Los'. Secondary and tertiary virial coefficients of difluoro-dichloromethane (Freon 12). IN: Voprosy teploobmena i termodinamiki (Institut tekhn. teplofiziki AN USSR), no. 1, 1971, 84-90. (LZhS, 37/72, no. 122182)

Fortov, V. Ye. Determining the accuracy of equations of state derived from statistical test data. IN: Trudy XV i XVI nauchnyye konferentsii Moskovskogo fiz.-tekhn. instituta, 1969-1970, Seriya Aerofizika i Prikladnaya matematika, part 1. Dolgoprudnyy, 1971, 113-121. (RZhMekh, 7/72, no. 7B1053)

Mamedov, A. M., and T. S. Akhundov. Relationship between equations of transfer coefficients and an equation of state for a liquid. I-FZh, v. 23, no. 3, 1972, 492-497.

Timoshenko, N. I., Ye. P. Kholodov, and A. L. Yamnov. Relationship of an equation of state for compressed gases to an optical complex and specific refraction. Virial coefficients of carbon dioxide. TVT, no. 4, 1972, 754-759.

vi. Atmospheric Physics

Arsen'yan, T. I., F. F. Pashkov, A. A. Semenov, A. A. Tishchenko, and N. N. Rimskiy. Interferometric investigation of phase fluctuation of coherent optical radiation in the atmosphere. IVUZ Radiofiz, no. 8, 1972, 1228-1232.

Astrelin, V. T., I. A. Bogashchenko, N. S. Buchel'nikova, and Yu. I. Eydel'man. Magnetized plasma flow around a plate. ZhTF, no. 8, 1972, 1715-1724.

Benediktov, Ye. A., G. V. Bukin, Yu. V. Kushnerevskiy, et al. Reception of Kosmos-381 signals from a conjugate point region. Kosmicheskiye issledovaniya, no. 2, 1972, 302-303.

Gorelik, A. G., L. V. Knyazev, L. G. Kotov, Ye. F. Orlov, and L. N. Uglova. Improved methods of statistical analysis of radar echoes with application to investigations of turbulence and vertical circulation. IN: Trudy Tsentr. aerol. observ., no. 103, 1972, 100-112. (RZhRadiot, 9/72, no. 9G44)

Dobryshman, Ye. M. Investigation of characteristics of atmospheric circulation in low latitudes. IN: Sbornik. Problemy obshchoy tsirkulyatsii atmosfery. Leningrad, Izd-vo Gidrometeoizdat, 1972, 6-12. (RZhMekh, 7/72, no. 7B956)

Il'in, V. D. Losses of ultrarelativistic electrons in a geomagnetic trap. Kosmicheskiye issledovaniya, no. 4, 1972, 626-627.

Knyazev, L. V., and L. N. Uglova. Radar measurement of wind velocity gradients in precipitation. IN: Trudy Tsentr. aerol. observ., no. 103, 1972, 113-133. (RZhRadiot, 9/72, no. 9G46)

Kolerskiy, S. V., Yu. V. Kuznetsov, S. O. Lekhtmakher, et al. Diffusion method measurement of concentration of highly-dispersed radioactive aerosols. IN: Doklady na Vsesoyuznoy konferentsii po yadernoy meteorologii, June, 1969. (Trudy Instituta eksperimental'noy meteorologii), no. 25, 1972, 95-101. (LZhS, 36/72, no. 118967)

Pustavalov, V. V., and A. B. Romanov. Parametric electromagnetic wave excitation of high frequency potential oscillations in a cold magnetoactive plasma. ZhTF, no. 8, 1972, 1648-1656.

Reshetov, V. D. Wind velocity pulsations in a boundary layer detected during atmospheric radio sounding. IN: Trudy Institut eksperimental'-noy meteorologii, no. 27, 1972, 151-153. (RZhMekh, 7/72, no. 7B996)

Snegerev, V. A. Spherical analytic solution of nonlinear equations of atmospheric dynamics. IN: Trudy Gidrometeorologicheskiy NI tsentr, SSSR, no. 92, 1972, 111-122. (RZhMekh, 7/72, no. 7B954)

Yeremin, B. G., A. G. Litvak, and B. K. Poluyakhtov. Thermal self-focusing of plasma electromagnetic waves. IVUZ Radiofiz, no. 8, 1972, 1132-1138.

vii. Miscellaneous Effects of Explosions

Arkhangel'skiy, N. A. Calculation tables for problems on cylindrical explosions taking counterpressure into account. IN: Trudy NII grazhdanskoy aviatsii, no. 71, 1972, 191-213. (LZhS, 37/72, no. 123212)

Azarkovich, A. Ye. Temperature calculations for application of water-bearing explosives. IN: Fiz.-tekhn. problemy razrabotki poleznykh iskopayemykh, no. 6, 1971, 49-55. (LZhS, 33/72, no. 109479)

Geyman, L. Brief survey on applications of explosives technology. Krasnaya zvezda, 9/13/72, 3.

Deribas, A. A., and G. Ye. Kuz'min. Motion of a metal pipe from explosive products effects. IN: Sbornik. Dinamika sploshnoy sredy, Novosibirsk, no. 8, 1971, 56-70. (RZhMekh, 7/72, no. 7B236)

Dremin, A. N., K. K. Shvedov, Ye. G. Baranov, et al. Detonation of industrial explosives. Detonation characteristics of aquanite-3 and water-bearing granulated trotyl. IN: Fiz.-tekhn. problemy razrabotki poleznykh iskopayemykh, no. 6, 1971, 46-49. (LZhS, 33/72, no. 109480)

Gerasimov, Yu. Ya. Calculation of radiation from a strong explosion. IN: Trudy Molodykh uchenykh Saratovskogo universiteta. Matematika i mekhanika, Saratov, 1969, 16-21. (RZhMekh, 7/72, no. 7L215)

Kashirskiy, A. V., Yu. V. Korovin, V. A. Odintsov, and L. A. Chudov. Numerical solution to a two-dimensional nonstationary problem of shell motion from detonation products effects. ZhPMTF, no. 4, 1972, 76-79.

Korobeynikov, V. P., P. I. Chushkin, and K. V. Sharovatova. Gazodinamicheskiye funktsii tochechnogo vzryva. (Gas dynamic functions of a point explosion). Izd-vo Vychislitel'nyy tsentr AN SSSR, 1969, 48p. (RZhMekh, 7/72, no. 7B221 K)

Korobeynikov, V. P., P. I. Chushkin, and L. V. Shurshalov. Theory with specific applications for a semi-infinite explosion of cylindrical charges. MZhiG, no. 4, 1972, 170.

Mel'nikova, N. S. Explosion in a medium with variable density, taking alternating counterpressure into account. PMM, v. 36, 1972, 626-635.

Problemy sovremennoy yadernoy fiziki. (Problems in modern nuclear physics. Collection of papers presented at the Second Special Symposium on Nuclear Physics. Novosibirsk, 12-19 June 1970). Moskva, Izd-vo Nauka, 1971, 543p.

Zvolinskiy, N. V. <u>Hydrodynamic theory of explosion effects and an incompressibility diagram.</u> PMM, v. 36, 1972, 726-731.

3. Geosciences

A. Abstracts

Krylov, S. V., A. L. Krylova, A. L. Rudnitskiy, and V. D. Suvorov. Deep seismic investigations in the transition zone from the West Siberian platform to the Kazakhstan folded region. Geologiya i geofizika, no. 6, 1972, 106-111.

The results of deep seismic investigations conducted in 1970 along a 600-km-long profile, using point seismic sounding, are described. The Shchuchinsk - Severnoye profile crosses the exposed caledonides of the Kazakhstan folded region, and the outer and inner zones of the southern part of the West Siberian platform (Figure 1). Additional areal point seismic sounding was conducted in the Omsk fault zone (see Figure 2).

(see figure on next page)

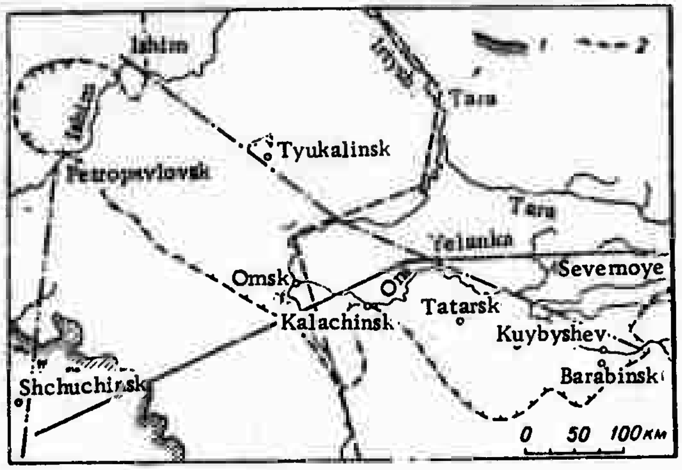


Fig. 1. Map of Profiles.

DSS profiles: —— considered in the article;
-·- Ishim - Barabinsk profile (Suvorov and others, 1971);
--- Irtysh profile (Krylov and others, 1969);
-··- Karaganda - Petropavlovsk profile (Antonenko and others, 1967);
1 - border of folded region;
2 - boundary between the outer and inner zones of the West Siberian platform.

The crustal velocity section along the Shchuchinsk - Severnoye profile is shown in Figure 3.

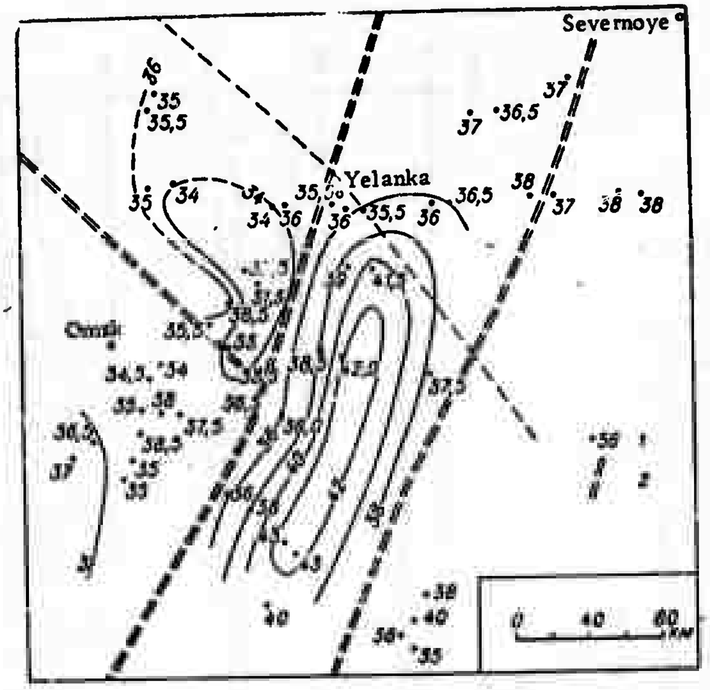


Fig. 2. Arrangement of the structure of the mantle surface.
1 - points where the depth to the Mohorovicic discontinuity is determined (in km); 2 - zones of deep-seated faults (the Omsk fault is shown by the thick line).

The most prominent regional feature revealed is the sharp difference between the crustal structure on the section of the profile crossing the Kazakhstan folded region and the outer zone of the West Siberian platform and the section crossing the inner zone of the platform. These two crustal blocks are separated by a zone of deep-seated foults which is located near the boundary between the outer and inner zones of the platform (50 km south of the Irtysh River). The first block is characterized by an increased thickness of 39 km and no continuous interfaces within the consolidated crust. The second block, with a thickness of about 35 km, is characterized by a sedimentary overburden of 3 - 3.5 km, a finely stratified consolidated crust, and, as in the other part of the West Siberian platform, an inverse

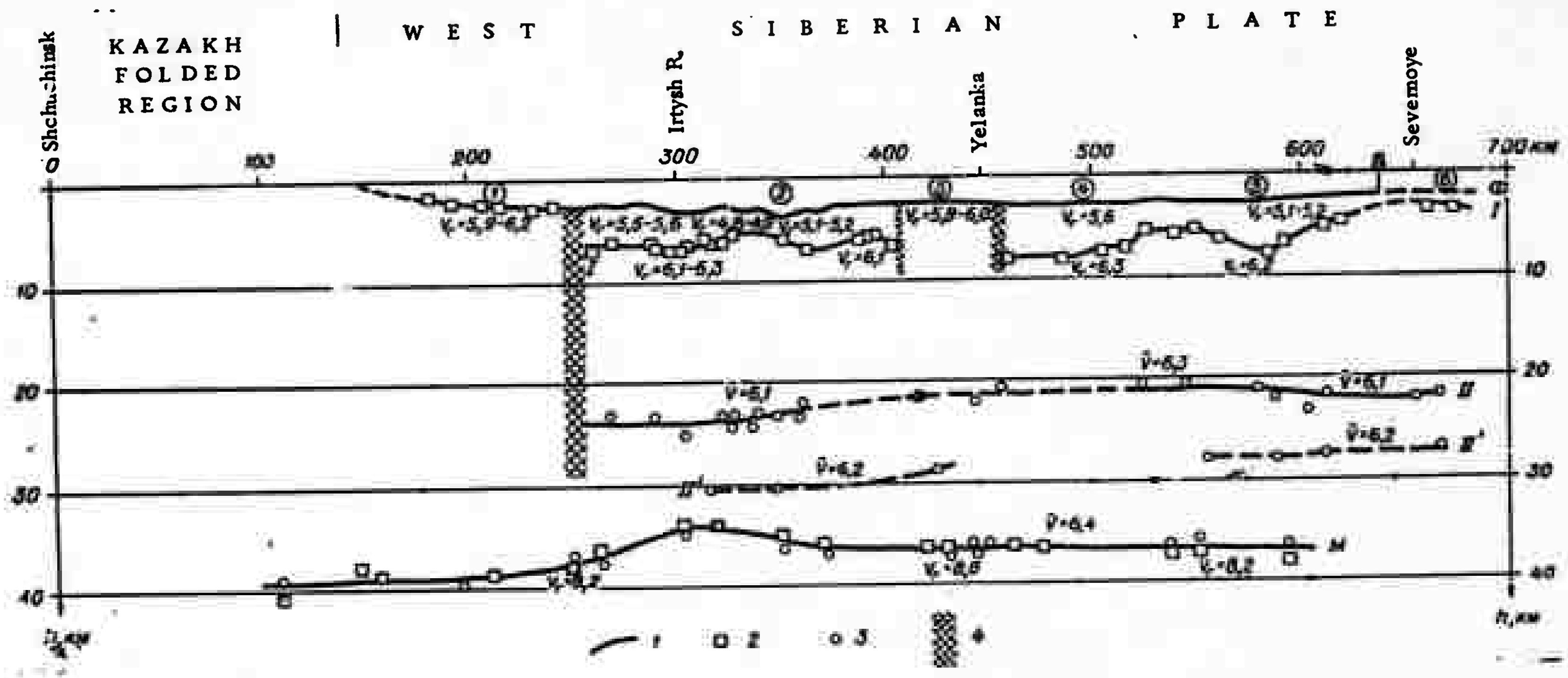


Fig. 3. Seismic Section

1 - seismic interfaces: Φ - basement surface, I, II, II' - intercrustal interfaces, M - Mohorovicic discontinuity; 2 & 3 - depths determined from reflected and refracted waves, respectively; 4 - assumed deep-seated faults; V_r, $\bar{V}$ - refractor and average velocities. Numbers within circles- major structures of platform cover: 1- Kazakhstan monocline, 2- Omsk depression, 3- Kalachinsk dome-like uplift, 4- Vorob'yev - Tebisskiy megaarch, 5- Kyshtov trough (basin), 6- Mezhov arch.

relief of interfaces (the most uplifted part of the Moho discontinuity corresponds to the most subsided parts of Φ interface in the Omsk depression, II, and II'. The 4-5 km thick layer between the Φ and I interfaces has relatively low velocity. In the arched part of the Kalachinsk dome-like uplift, sedimentary cover lies directly on the geosynclinal basement (interface I), which here has a refractor velocity of 0.1 - 0.3 km/sec less than on the slopes of the uplift.

The following interfaces are identified:

Interface Φ forms the basement surface having a depth range of 0 - 3.5 km, with a highly differentiated refractor velocity of 4.8 - 6.2 km/sec.

Interface I lies within the depth range of 4 - 8 km, with a refractor velocity of 6.1 - 6.3 km/sec characterized by a high velocity contrast.

Interfaces II and II' lie at depth ranges of 21 - 24 and 27 - 30 km, respectively, but are not very reliably determined. The Mohorovicic discontinuity occurs in the 34 - 39 km depth range along the profile and is at 32 - 43 km in the Omsk fault zone; its refractor velocity is 8.0 - 8.2 km/sec. The average velocity of the consolidated crust is 6.4 km/sec.

The relief of Mohorovicic discontinuity in the Omsk fault zone, as deduced from the present data and data previously obtained for the West Siberian platform, is shown in Figure 2. West of the Omsk fault zone, which obviously penetrates the upper mantle, there occurs a crustal block with a thickness of 32 - 35 km, which is the minimum thickness for the entire West Siberian platform. To the east of the fault zone, the crustal thickness increases abruptly to an anomalously high value of 42 - 43 km. A narrow block east of the Omsk fault zone also has anomalous thickness and structure, and is intersected by transverse faults; this block probably extends southward to the exposed caledonides of Kazakhstan.

Pustovitenko, B. G., A. N. Pustovitenko, and S. L. Solov'yev. Tilt observations on the Island of Shikotan. IN: AN SSSR. Doklady, no. 1, 1971, 94-96.

Tilt observations on the Island of Shikotan in 1967-1970 are considered, and a correlation of observed tilt variation to earthquakes occurring in the above period is established. Instrumentation included stable tiltmeters installed in a tunnel, and the observations were not affected by precipitation, wind and fluctuations of ambient pressure and temperature. The records obtained were nearly identical to those obtained at observing stations distant from the ocean. The observed diurnal tilt variations were due to both earth and ocean tides. Annual and secular tilt variations were less affected by the proximity of the ocean.

The mean value of γ determined from semidiurnal variations were $\gamma_{Ns} = 0.980 \pm 0.195$ and $\gamma_{Ew} = 0.629 \pm 0.083$. In the observation periods, two strong earthquakes occurred: in January 1968 with M = 7 and in August 1969 with M = 8.25 followed by a strong aftershock in February 1970. The intensities registered in the observing station area were 6 - 5, 7 - 8, and 5, respectively. The earthquakes of 1969 and 1970 were preceded by an abrupt tilt variation. The changes were less than 2.5" in a north-south direction. After the events, the trend of the tilt variation remained unchanged over a rather long period (1 - 3 months). These tilt observations confirm the conclusions drawn from observations, on the direction of the displacement or fault created during the 1968 and 1969 earthquakes.

Zakharova, A. I., and S. S. Seyduzova. Earthquake intensity attenuation in the Uzbekistan region. Uzbekskiy geologicheskiy zhurnal, no. 4, 1969, 41-45.

Empirical expressions are derived for the dependence of earthquake intensity on distance from the epicenter, and intensity at the epicenter on the energy relationship for the Uzbekistan region. Macroseismic data on 22 earthquakes ($M = 4 - 7\ 1/2$; $K = 11 - 17$; $h = 8 - 35$ km; $\Delta = 7 - 400$ km) recorded in Uzbekistan from 1897 to 1966 are used. Data on earthquakes are given in a table in terms of epicentral coordinates, focal depth, magnitude, energy, and intensity at the epicenter. An analytical expression for $I_o - I_i = f(\Delta, h)$ was assumed to be

$$cM - I_i = a + b \log \Delta$$

assuming $K = 1.8M + 4$ and $C = 1.5$, with the numerical parameters $a = -0.35$, $b = 1.93$ and $a = -0.01$, $b = 1.94$ in the direction parallel to and across the strike of the isoseismal lines, respectively. An analytical expression for the relationship of intensity at the epicenter to energy class was assumed to be

$$I_o = d + cK$$

and the coefficients derived are $d = -4.65$, $c = 0.84$.

Rautian, T. G., and G. I. Pavlova.
Regional aspects of seismic-wave attenuation in the Naryn basin during local earthquakes. IN: AN SSSR. Institut fiziki Zemli. Eksperimental'naya seysmologiya (Experimental seismology). Moskva. Izd-vo Nauka, 1971, 112-118.

The attenuation of seismic waves from local earthquakes was studied to obtain information on crustal structure. Seismograms of earthquakes corresponding to seven small epicentral regions (~100 km^2) recorded by eleven closely spaced seismic recording stations (30 km apart) were analyzed. The groups of earthquakes were selected in such a way that it was possible to use opposed systems of observations at two or more stations.

The deviation of the value of the earthquake energy class determined for each station from the average value for all stations $\delta K = K_i - \overline{K}$ was used for evaluating the deviation of amplitude from the calibration curve

$$\delta \log A_{ij} = 0.56\ \delta K_{ij}$$

δK_{ij} is determined for the pair of i-th observation station and j-th epicentral section as an average value for a large number of earthquakes. A histogram of the deviation of amplitudes was compared with normal distribution and the large deviations were found to be not random, but determined by the characteristics of the medium.

Differences $\varphi = (\delta \log A^*)_1 - (\delta \log A^*)_2$ for two seismograph stations (where $\delta \log A^*$ is the corrected $\delta \log A$) which represent local features of attenuation have been analyzed. Sharp differences in the attenuation in various sections of the region (higher in the Naryn River valley and its left side and lower in right side) were noticed. It is

assumed that the Naryn River valley forms a boundary between two structurally different sections. This result is compared with a macroseismic study of an earthquake in the region and found to be in agreement.

Nazarov, A. G. On the problem of earthquake prediction. IN: Akademiya nauk Armyanskoy SSR. Doklady, v. 53, no. 1, 1971, 26-31.

An attempt has been made to determine the length of time, Δt_0, from the origin of an earthquake precursor to the earthquake onset, using developments in the similarity theory of deformable solids (Nazarov, A. G., 1965) and empirical findings (Shebalin, N. V., 1969).

An argument of similarity between the earth's crust A and its model A' is given, and two particular cases of similarity are described as follows:

1. If $E' = E$ and $g' = g/\alpha$ then $t' = \alpha t$, $L' = \alpha L$, $h' = \alpha h$.
2. If $E' = \alpha E$ and $g' = g$ then $t' = \sqrt{\alpha} t$, $L' = \alpha L$, $h' = \alpha h$,

where E, g, t, L, h, and E', g', t', L', h' are elastic modulus, gravity acceleration, time, linear hypocenter length, and depth of hypocenter for A and A', respectively, and α is the factor of geometric similarity.

It is further argued that the first case of similarity holds true for processes in small hypocenters generating weak earthquakes, while the second case obtains for large hypocenters and strong earthquakes. It is postulated that in the crust there exist classes of relatively weak (small hypocenters) and strong (large hypocenters) earthquakes approximately similar to each other. The postulate has merit under

the conditions that: a) the interval between largest hypocenter of the first class of earthquakes and smallest hypocenter of the second class of earthquakes is not large; and b) the size of the hypocenter, rather than its shape and depth, is of predominant importance for earthquake parameterization. Evidence that these conditions hold true was found in empirical findings (Shebalin, 1969) on the relationship of the maximum period of compressional waves to hypocenter length,

$$T(\text{sec}) \approx 2\ell(\text{km}) \text{ for } M \leq 5$$
$$T(\text{sec}) \approx 2.8\sqrt{\ell}(\text{km}) \text{ for } M > 5.$$

If ℓ' designates the length of the smaller hypocenter,

$$T' = \alpha T \quad \text{for } M \leq 5$$
$$T' = \sqrt{\alpha} T \text{ for } M > 5, \text{ where } \alpha = \frac{\ell'}{\ell},$$

which correspond to the time scale in the previously discussed case of similarity. It is further postulated that the scale factors for period can be approximately extended to Δt_0. Thus, using empirical magnitude-to-hypocenter-length formulae and assuming that Δt_0 = a for magnitude 1, a table relating Δt_0 to M or ℓ is obtained. The common ratio of the progression up to M = 5 is $\sqrt{10}$ and $\sqrt[3]{10}$ for M = 5 - 8.

Gryaznovskaya, F. V., A. V. Polyakov, and I. M. Pudovkin. Preliminary results of the study of secular-variation anomalies in the South Kazakhstan seismically active zone. Geomagnetizm i aeronomiya, no. 1, 1972, 157-161.

The initial results of the observation of anomalies in the secular variation of the geomagnetic field due to physical processes at earthquake hypocenters are discussed. D, H, T, and Z were measured in 1968 and 1969 over a network set up in the South Kazakhstan seismically active zone. Root mean square errors of individual measurements were D =~± 1.5 - 2', H =~6γ, Z =~5γ, and T =~± 3γ, respectively. The observation results for the Z and H components are presented. Maps are

given for δZ_a isopors (where $\delta Z_a = \delta Z_i - 1/n \sum_{1}^{n} \delta Z_i$; i = 1, 2...n, $\delta Z = Z_{1969} - Z_{1968}$), with δH_a values, δZ_a isopors (superposed over the systems of deep-seated faults in the region), and seismic zonings shown.

It was found that the δf_a field is highly complex and variable. δZ_a varies abruptly with frequent oscillating changes (from +38 to -31 γ/yr). δH_a vectors amounting to as much as 50γ are oriented in different directions. The most distinctive areal features of the δZ field coincide with zones of recent subsidence. In addition, a zone with a high δZ_a variation rate extends along the northern boundary of a zone of the greatest seismic hazard.

It is concluded that processes in hypocenters of earthquakes are localized to the same degree to which secular-variation anomalies are also localized. The depths at which physical processes occur are comparable to the transverse dimensions of the anomalies (less than 10 km). It is suggested that thermomagnetic transitions in the hypocenters of the South Kazakhstan earthquakes may play a dominant role in the generation of the anomalies, although the possible roles of other physical processes are not ruled out.

Grigor'yev, S. S., L. A. Misharina, and Ye. I. Shirokova. Tectonics of the Azores-Gibraltar transverse structure and its reflection in the stressed state of the crust. IN: AN SSSR. Doklady, v. 197, no. 6, 1971, 1421-1424.

The results of the study of the state of stress in the seismically active Azores-Gibraltar structure are presented. A focal-mechanism solution for Azores-Gibraltar earthquakes is derived from data of the world wide network of observing stations, using Vvedenskaya's dislocation model. The results are shown in a table and map.

Tensile and compression stress axes are subhorizontal, with the former oriented in a northeasterly direction and the latter at a 40° - 80° angle with respect to the 35° N parallel. Two possible fault planes slope steeply with a west-northwest and northwest strike. Strike-slip displacement on the fault planes prevails. The possible fault planes whose strikes coincide with sublatitudinal faults are interpreted as real fault planes in hypocenters. The Azores-Gibraltar zone is characterized by a stable stress state. The stress state of the supposed Azores deep fracture is characterized by a compression axis oriented along and across its strike, as well as in a submeridional direction. This intricate stress-axis pattern is related to alternate exertion of oblique and meridional stresses. On the basis of the stress state thus revealed, the supposed Azores fracture is attributed to an ocean ridge region. It is concluded that the results of the stress-state analysis confirm the hypothesis that the Azores-Gibraltar structure originated from oblique stresses along the 35° N strike-slip zones.

Yepinat'yeva, A. M., Ye. V. Karus, and M. V. Nevskiy. <u>The nature of velocity anisotropy of seismic waves in sedimentary strata</u>. IN: AN SSSR. Doklady, v. 201, no. 2, 1971, 331-334.

In this article, the experimental proof is given for velocity anisotropy in sedimentary strata and its correlation with the thin stratification of the velocity model. The experiment was performed with ultrasonic well-logging and vertical seismic profiling methods in two types of media: 1) thin-layered, composed of two sharply differing (lithologically) alternating components (rock salt and sandy-clayey rock), and 2) single-layered (rock salt).

Velocity sections obtained through ultrasonic well-logging were thin-layered and homogeneous for type 1 and 2 media, respectively. From the ultrasonic well logging data, the velocity in a direction perpendicular to stratification and the anisotropy coefficient were estimated by approximate formulas developed for a two component multiply thin-layered medium. Estimated values for the anisotropy coefficient were 1.10 and nearly unity for the type 1 and type 2 media, respectively.

From the vertical seismic profiling data, the compressional-wave velocity along inclined rays (Θ= 63-85) was obtained. It is shown that in the type 1 medium, the velocity in the direction of nearly horizontal rays exceeds the layer velocity by 400 m/sec, whereas in the type 2 medium, the velocities in the direction of inclined rays are practically identical to the layer velocity. An experimental v_p (Θ) curve is consistent with the theoretical one calculated for a two-component multiply thin-layered medium. It is concluded that the seismic quasianisotropy theory is applicable to a real medium.

Yegorkin, A. V. Velocity characteristics of the crystalline part of the Earth's crust. Priroda seysmicheskikh granits v zemnoy kore (Nature of Seismic interfaces in the Earth's crust). Moskva. Izd-vo Nauka, 1971, 32-44.

As analysis is made of the kinematic characteristics of wave groups confined to the interfaces in the crystalline* crust, in order to study its velocity anisotropy. Extensive experimental DSS data were used in the analysis.

Graphs of apparent velocity vs distance $V^*(R)$, effective velocity vs distance $V_{eff}(R)$, layer velocity vs angle of incidence $V_n(i)$ and layer velocity vs $p = \sin i/V_n$ are plotted and discussed.

It was found that tne majority of the $V_{eff}(R)$ curves do not correspond to a layered isotropic medium. From the analysis of $V_n(p)$ curves it was found that in all layers in the crystalline crust, V_n decreases irregularly with the angle of incidence of the seismic ray, and for $i = 70 - 75^\circ$, all layer velocities are adjusted and are equal to the velocity of compressional waves in the upper part of the crystalline crust. Thus, for $i = 70 - 75^\circ$, the crystalline crust can be regarded as a homogeneous layer with $V_n = 5.8 - 6.4$ km/sec.

Orientation of rock-forming minerals with anisotropy of elastic properties is discussed as a possible cause of velocity anisotropy observed. It was concluded that velocity anisotropy in deep crustal layers, due to orientation of rock-forming minerals, is quite probable.

* author's term for consolidated crust

Gol'din, S. V. Statistical methods of identification of reflected waves with complete a priori information. Diskretnaya korrelyatsiya seysmicheskikh voln (Discrete correlation of seismic waves). Novosibirsk, Izd-vo Nauka (Sibirskoye otdeleniye), 1971, 14-49.

A statistical theory is developed for identifying reflected waves on single seismograms by means of a set of wave parameters, when complete information on the probability distributions of these paramenters is available.*

The problem of wave identification is solved by the statistical methods of successive and simultaneous pattern recognition. These methods are considered with special attention paid to the Gaussian approximation of probability distributions and the method of a linear discrimination function. In connection with this, the selection of informative parameters of the discrimination function, as well as the dependence of identification reliability on the distance to the standard sample are discussed. Wave identification on each seismogram is accomplished by taking into account the correlation on preceding seismograms and the interrelation of all waves traced.

*) The statistical theory can be used for defining specific identification criteria, if a sufficiently dense standard sample is available. These conditions are fulfilled if discrete observations are made in the proximity of a well investigated region characterized by a stable wave field.

Gol'din, S. V., L. I. Matys, N. N. Poplavskiy, A. P. Lisenkov, and V. A. Soldatov. Experiments with statistical methods for the identitication of seismic waves in West Siberia. Diskretnaya korrelyatsiya seysmicheskikh voln (Discrete correlation of seismic waves). Novosibirsk, Izd-vo Nauka, (Sibirskoye otdeleniye), 1971, 73-102.

This article is an extension of the preceding article "Statistical methods of identification of reflected waves with complete a priori information" by S. V. Gol'din, demonstrating an experimental verification of the statistical method for wave identification developed in the original article. A discrete observation system was simulated by taking 167 seismograms, one for every 2-5 km of a continuous profile which was employed in a reflection survey of the West Siberian platform. The experiments showed that the method of linear discrimination function, based on a Gaussian approximation of multidimensional parameter distributions, provides high wave discrimination reliability. Sufficiently good identification is achieved with 6 - 8 parameters. An analysis of the informative value of the parameters showed that time-related parameters are the most informative, especially for identification with an accuracy to a wave. The parameters describing the interrelationship between the traced wave and adjacent ones, as well as waveform, are relatively highly informative for identification accurate to a phase. The experiments showed that statistical methods of wave identification provide an error probability not exceeding 5% or less than 3% when using the procedure of simultaneous wave identification.

Criteria obtained for wave identification are very unstable when using a low-quantity standard seismogram sample, particularly in the procedure of simultaneous wave identification. In addition, the restrictions on the size of the standard sample limit the use of all available data.

Abdullabekov, K. N., and V. P. Golovkov. Local variations of the geomagnetic field on the Tashkent geodynamic test site. Geologicheskiy zhurnal, no. 3, 1971, 89-90.

Anomalous variations of the geomagnetic field observed in 1968 to 1970 at the Tashkent geodynamic test site are described. One anomaly with a maximum change of -23γ, occurring on a section of the test site over a distance of a few kilometers, indicates the significant depth of its source (15 - 20 km). Its maximum was reached in 1968 - 1969, after which it started diminishing. A second anomaly with an amplitude of 10 - 15γ/yr was observed over a 30 km section of the site. The dimensions of this anomaly suggest that its source is either deep or shallow with large dimensions. The anomalies observed were not associated with earthquakes; although their amplitudes are too high for them to be considered of a seismomagnetic nature. Their variation rate suggests a relationship with physical processes occurring at earthquake hypocenters.

Zhak, V. M., and S. L. Solov'yev. Remote recording of weak tsunami waves on the Kurile Islands shelf. IN: AN SSSR. Doklady, v. 198, no. 4, 1971, 816-817.

In order to test the feasibility of a hydrophysical method for tsunami prediction, two monitoring units were installed on the ocean floor 10 and 20 km off Shikotan Island at depths of 60 and 120 m. The units include a DDV-20B pressure sensor (frequency range 0 - 10 Hz, dynamic range 0 - 20 atm), a hot-probe current meter, and KMT-4 thermistors for measuring water temperature. Data were transmitted by an electrical cable between the instrument packages and shore. During

a six month period, 60 weak waves with 10 - 100 min periods, which are characteristic of tsunamis, were recorded. More than 10 of these waves were undoubtedly generated by local earthquakes having typical tsunami waveform. Part of them were generated by meteorological events and the nature of the remainder is not explained. The passage of a tsunami disturbs all hydrophysical fields; the amplitude of swell increases by a few times, turbulence intensity sharply increases, and water temperature increases by 1^{o}. Equilibrium is reestablished in 4 - 8 hours.

Aleynikov, A. L., and N. I. Khalevin.
Study of anisotropy of elastic wave velocity in the Earth's crust. Geologiya i geofizika, no. 2, 1971, 113-117.

The authors assume that velocity anisotropy observed in deep seismic sounding (DSS) is caused by elastic anisotropy due to elastic stresses acting within the crust and upper mantle. This effect on the results of DSS is analyzed, and a method for considering velocity anisotropy in the interpretation of DSS data is proposed.

An equation for the time-distance curve of reflected waves in a two-layered homogeneous and anisotropic medium with a horizontal interface is given:

$$t = t_0 \sqrt{\frac{1}{4\alpha^2} + \frac{x^2}{h^2} + 1}, \tag{1}$$

where α is the anisotropy coefficient determined as the ratio of the horizontal v_x and vertical v_y velocities. Theoretical time-distance curves calculated for α = 0.85, 1.00, 1.15 are shown in a graph. A method of interpreting experimental time-distance curves, taking velocity

anisotropy into account, is suggested. It is shown that the average velocity in an anisotropic layer depends on distance x to the observation point

$$v_{cp} = \frac{v_y}{\sqrt{\dfrac{\dfrac{x^2}{h^2 a^2} + 4}{\dfrac{x^2}{h^2} + 4}}}. \qquad (2)$$

and as x increases, v_{av} asymtotically approaches v_x.

The effect of anisotropy can result in a distorted reflection surface which is expressed by

$$h^* = \frac{h}{2}\sqrt{\left|4 - \frac{x^2}{h^2}\left(1 - \frac{1}{a^2}\right)\right|}. \qquad (3)$$

It is noted that data on velocity anisotropy can be used in seismctectonic zoning and in the study of the nature of recent tectonic processes.

B. Recent Selections

Ankudinov, S. A., N. N. Bolgurtsev, I. V. Litvinenko, and G. A. Porotova. Deep geological structure of the eastern part of the Karelia area, based on the results of comprehensive geophysical studies (Lake Onega - White Sea profile). Geotektonika, no. 5, 1972, 75-78.

Birger, B. I., and V. N. Zharkov. Thermal stresses in a gravitating Earth. AN SSSR. Izvestiya. Fizika Zemli, no. 9, 1972, 3-10.

Garkalenko, I. A., M. I. Borodulin, and A. K. Mikhalev. Certain problems in the structure and oil-bearing prospects of the southern end of the Donets foredeep, based on DSS data. Heolohichnyy zhurnal, no. 4, 1972, 11-19.

Holub, K. Level of seismic noise in the West Carpathians. Ceskoslovenska akademie ved. Geofysikalni ustav. Geofysikalni sbornik, no. 17 (1969), 1972, 115-128.

Karmaleyeva, R. M. Study of long-period surface waves, using quartz extensometers. AN SSSR. Izvestiya. Fizika Zemli, no. 9, 1972, 25-38.

Karnik, V., and Z. Hubnerova. The probability of occurrence of largest European earthquakes in different periods. Ceskoslovenska akademie ved. Geofysikalni sbornik, no. 17 (1969), 1972, 65-78.

Kosminskaya, I. P., N. N. Puzyrev, and A. S. Alekseyev. Explosion seismology - its past, present, and future. IN: AN SSSR. Vestnik, no. 9, 1972, 44-54.

Krylov, S. V., A. L. Krylova, A. L. Rudnitskiy, and V. D. Suvorov. Deep seismic studies in the transition zone from the West Siberian plate to the Kazakhstan folded region. Geologiya i geofizika, no. 6, 1972, 106-111.

Mirlin, Ye. G., V. R. Melikhov, O. V. Mikhaylov, and Yu. P. Neprochnov. The nature of magnetic anomalies in the Black Sea Basin. AN SSSR. Izvestiya. Seriya geologicheskaya, no. 9, 1972, 60-71.

Potap'yev, S. V., A. N. Sinyukov, and V. G. Korneyev. Seismic field work involving aerial bombing. Geologiya i geofizika, no. 7, 1972, 82-90.

Reysner, G. I. Comprehensive study of the crust and upper mantle (conference). IN: AN SSSR. Vestnik, no. 9, 1972, 115-116.

Sollogub, V. V., A. V. Cherkunov, and A. A. Tripol'skiy. Tectonic regioning of the Ukrainian shield, based on deep geophysical research. Heolohichnyy zhurnal, no. 4, 1972, 3-10.

Tobyas, V., and Z. Hubnerova. Equivalent and partial constants of electromagnetic seismographs. Ceskoslovenska akademie ved. Geofysikalni ustav. Geofysikalni sbornik, no. 17 (1969), 1972, 79-113.

4. Particle Beams

A. Abstracts

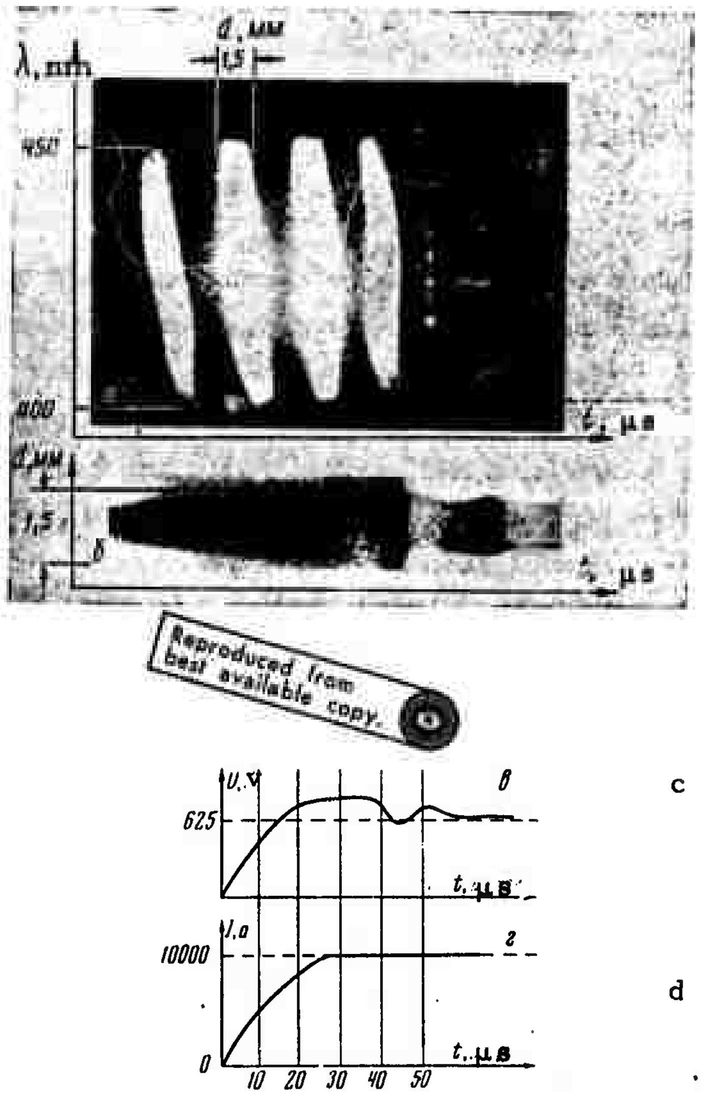
Demidov, M. I., N. N. Ogurtsova, I. V. Podmoshenskiy, and V. M. Shelemina. On the instability of a capillary discharge with evaporating wall. TVT, no. 5, 1971, 890-895.

An experimental determination and analysis is given of the instability conditions of a capillary discharge with evaporating walls. A qualitative description of the instability phenomenon is included, with analysis of optical and electrical characteristics of the plasma in two states. The instability occurs in a spontaneous, uncontrolled transition from a state with minimal temperature for the given conditions and radial heat exchange to a state with maximal temperature, which assures the dissipation of heat by thermal conductivity of electrons. The instability is observed when the magnetic pressure of the discharge current is very large and commensurable with the plasma gas pressure. This condition takes place at approximately 10^9 - 10^{10} w/cm^3, when a very high plasma temperature is reached (with the average particle energy of the order of 100 ev). The instability is apparently caused by the effect of magnetic forces of the discharge current on plasma acceleration, breakdown of the established rate of mass flow and corresponding decrease in plasma density. With decreased density, the radiative ability of the plasma decreases which contributes to a further decrease in evaporation rate of the capillary walls, with the resultant effect of further lowering the radiation ability and increasing the rate of flow. The increase in electrical conductivity of plasma with temperature increase causes contraction of the current channel and the increase of magnetic pressure; thus the change of plasma density can cause a self-accelerating transition process in a gas discharge.

In the tests, C_2H_4 and $C_5H_8O_3$ capillary tubes with 0.5 - 0.7 mm diameter and 0.5 - 3 mm long were used. Plasma temperature was estimated from the conditions for the discharge energy balance. Continuous and line spectra and their relative intensities were analyzed. Line spectrum was characteristic of the "minimal temperature state" ($\sim 6 \times 10^4$ °K), and continuous - of the "maximal temperature state" ($\sim 4.5 \times 10^5$ °K). The nature of the capillary diameter changes were analyzed for both states. Deformation of the capillary walls in the minimal temperature state is attributed to a substantial increase of plasma pressure. Discharge current, voltage gradient, plasma density and pressure were determined for both states. The transition times between the two states were calculated. Assymetry of structure and velocity of plasma jets emitted from the capillary tubes was observed in the maximal temperature state. The authors point out that the data obtained on the properties of plasma in the maximal temperature state should be considered as a rough approximation because of the uncertainty of the presence of the thermodynamic equilibrium in this state, and because the possible effect of magnetic field of the discharge current on the transfer coefficients in plasma was not taken into account. An example of test results with a polyethylene capillary are shown in Fig. 1.

a

b



c

d

Fig. 1. Characteristics of a 10 ka discharge through a 2.5 x 0.68 mm polyethylene capillary. a - Spectrochronograpy record, 10^5 frames/sec., 2 μs exposure; b - illuminated channel width; c - capillary voltage; d - discharge current (total width = 90μs)

Jelen, J. A model of plasma acceleration similar to the "snow-plow" model. Czechosl. J. Phys., v. 22, no. 3, 1972, 181-188. (RZhF, 6/72, no. 6G335)

A plasma acceleration model similar to the "snow-plow" model is analysed on the assumption that effective acceleration exists only at the accelerated gas front, where all discharge current flows in a relatively thin layer. Time characteristics are obtained for the distance covered and the velocity of the acceleration front. Gas density distribution in the acceleration zone and the relative portion of the energy transmitted to the plasma are determined. Although the assumption on the confinement of "skimming" gas was not made, the results obtained were very close to those of the "snow-plow" model.

Adeyshvili, D. I., I. A. Grishayev, N. I. Mocheshnikov, and A. Ye. Tolstoy. Decreasing the duty factor of linear accelerator operation. Atomnaya energiya, v. 33, no. 1, 1972, 593-594.

By the addition of a storage element, pulsed linear electron accelerator beams were transformed into a γ- quantum flow, variable in intensity and duration over a wide range. The experiment was performed in a storage element containing an injector made up of the first five sections of a 300 Mev linear electron accelerator. The accelerator operating conditions were: electron energy, 70 Mev; pulsed current, 50 ma at 1.2 μsec; and injection frequency, 1-50 Hz. Figure 1 is a

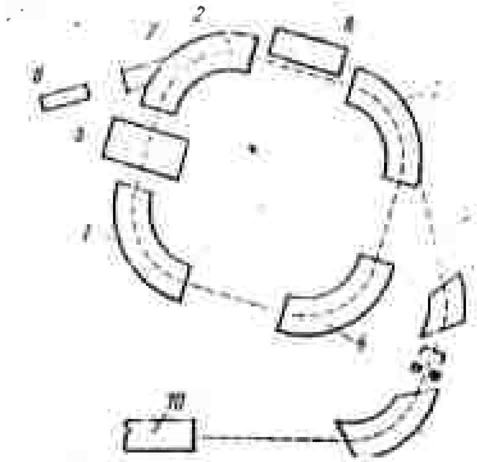


Fig. 1. Experimental device. 1, 2, 3, 4 - quadratic storage element; 5 - HF gap; 6 - - quantum detector; 7 - target; 8 - inflector; 9 - electron beam injection trajectory; 10 - accelerator output.

block diagram of the experimental device. Interaction of the circulating beam with the target (a 35μ copper wire) was established in two ways. In the first, the target remained fixed in the storage element chamber in a balanced trajectory, and particles were injected at a constant frequency in the target presence. This procedure made it possibile to obtain a quasi-continuous γ- quantum beam with a duty factor $\lesssim 10$ (dependent on the parameters of the storage element, the injector and the target) and to spread the beam by a factor of 10^3. In the second procedure, a maximum number of particles were built up before the target was introduced. The target was removed after the interaction and the cycle was repeated. This method yielded a "cleaner" effect since the target was placed in the steady-state circulating electron beam, when the accelerator-injector was switched off. Using the second method, measurements were simultaneously made of synchrotron emission and bremsstrahlung. The circulating beam lifetime was determined and

results were plotted (Fig. 2).

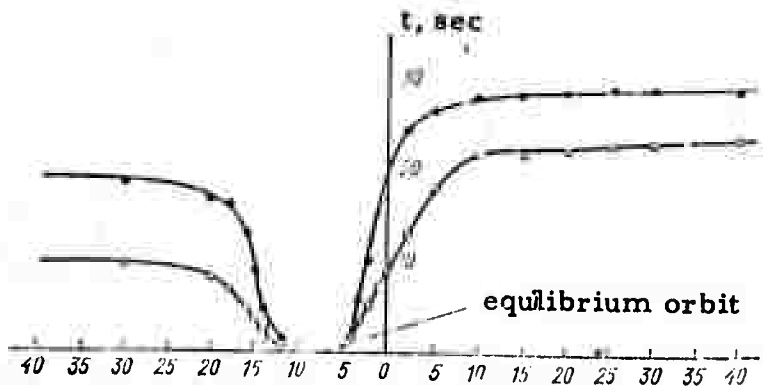


Fig. 2. Relationship of electron beam lifetime in the storage element to target position.
● synchrotron emission
O bremsstrahlung

An improved vacuum in the storage chamber (6×10^{-8} torr) provided a target-free storage beam lifetime of 240 seconds. Time characteristics were plotted for beam intensity at various relative locations of the electron trajectory and the target. Measurements at 5-8 ma circulating current corresponded to $(6\text{-}9.6)\ 10^{8}$ electrons in the storage element and an integral γ- quantum output of $\sim 10^{7}$. According to the authors, it would be possible under the above conditions to achieve a photon output to 10^{9}-10^{10}, if the number of accumulated particles is increased to 10^{11}.

Basman, A. R., A. B. Gerasimov, N. D. Dolidze, N. G. Kakhidze, and B. M. Konovalenko. Annealing of radiation defects in p-type Ge specimens. FTP, no. 7, 1972, 1398-1399.

The work discusses an experimental verification of whether vacancy concentrations recovery in p-type Ge specimens exposed to fast electrons after annealing at 410°K, results in a full restoration of the initial perfect crystal lattice. The lifetime recovery τ was investigated in the process of isochronous annealing in p- and n-type Ge specimens, irradiated at 77°K by 4 Mev electrons. Measurement of τ was based on photo-conductivity relaxation during specimen illumination by a flash lamp, ensuring a sufficiently high excitation level. After annealing in the range of 77° - 300°K, measurements were taken at 77°K, and at room temperature following further stages of annealing. Figure 1 shows the room temperature results as well as the recovery of carrier concentrations in the annealing process. It is noted that despite the fact that lifetime restoration in p-type specimens started at approximately 350°K (before the carrier concentration recovery stage), a significant amount of τ increase from the initial value occurred at T>420°K, when the recovery of carrier concentration had already ended. A comparison of τ-isochronous annealing curves for the n- and p-type specimen reveals that recovery lifetime occurs during the same temperature interval: 350° - 570°K. The final recovery of electron concentration also occurs at this temperature interval, which indicates the burning-off of acceptor defects. The recovery lifetime in n- and p-type Ge is related to the disappearance of acceptor levels owing to the annealing of radiation defects. With full recovery of vacancy concentrations at 410°K, a comparatively high concentration of acceptor radiation defects with high energy levels consequently survives. These burn off completely at 570°K only.

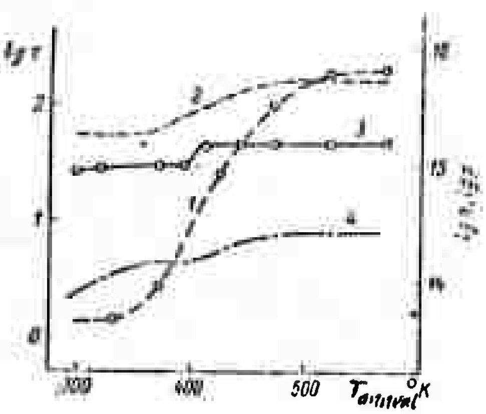


Fig. 1. Change of lifetime τ (1,2) and carrier concentration (3,4) due to isochronous annealing in specimens.
1,3: - p-type, $N_{Ga} = 6.95 \times 10^{14} cm^{-3}$, $\phi = 4.5 \times 10^{16}$ el/cm^2;
2,4: - n-type, $N_{Sb} = 2.5 \times 10^{14} cm^{-3}$, $\phi = 9.0 \times 10^{13}$ el/cm^2.

Suntsova, S. P., A. Yu. Ushakov. High current pulse generator. IN: Trudy LPI no. 325, 1971, 114-116.

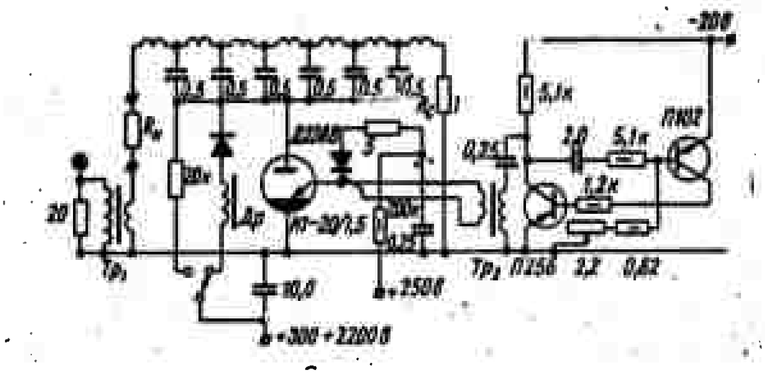


Fig. 1. Pulsed current generator

A description is given of a high current pulse generator (Fig. 1) which operates under the principle that after a line is charged, at the moment of closing the commutating element two traveling waves are generated in the line. One of the waves travels towards the operating load Rh; the other towards the matching load Rc. The value of Rc selected is equal to the line wave impedance so that the corresponding wave attenuates in the load. If the Rh simultaneously differs from the line wave impedance, a portion of energy is reflected from the working load and, after returning along the line, is absorbed in Rc. Rectangular pulses of adequately regular form can consequently be obtained in the load, independent of its value. Generator operating parameters are: interval resistance-1 ohm; open circuit pulse amplitude - variable from 3.6 to 280 v, generated pulse duration - 2.5 μsec; leading edge - 0.3 μsec and trailing edge - 0.6 μsec; and pulse repetition frequency - continuously variable from 0.5 to 3 Hz. Tests show that clean pulsed currents up to 2 ka are obtainable with this circuit.

Petrenko, V. I., R. V. Mitin, Yu. R. Knyazev, and A. V. Zvyagintsev. High-current pulsed arc in hydrogen at pressures to 400 atmospheres. IN: Fizika plasmy i problemy upravlyayemogo termoyadernogo sinteza. Kiyev, izd-vo Naukova dumka, no. 1, 1971, 205-212.

Experiments in initiating a high pressure pulsed discharge in hydrogen to generate and investigate properties of a dense hydrogen plasma are discussed. The experimental device comprised a high-pressure discharge chamber, a thermo-compressor and condenser batteries. The discharge chamber was a thick-walled cylindrical metal vessel, designed for a maximum operating pressure of 1000 atm. The chamber had three diagnostic windows for conducting optical, photographic and other observations; chamber gas volume was about 1 liter. The thermocompressor maintained the required system pressure, and a liquid nitrogen coolant ensured a chamber hydrogen pressure of 500 atm. The pulsed discharge was initiated using a 0.7 mm copper wire between electrodes fitted with tungsten terminals as shown in Fig. 1. The condenser

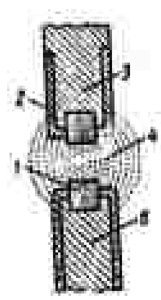


Fig. 1. Discharge configuration

1 - tungsten inserts; 2 - textolite cap;
3, 5 - electrodes; 4 - plasma

battery, with a capacitance of 8000 μf, was discharged through the conductor wire establishing an operating voltage of 2.5-3kv. Arc current was about 60 - 70 ka, with a pulse duration of 0.6 msec and a stable arc length up to 20 mm. The electrical characteristics of the pulsed hydrogen arc were studied and the visible brightness was measured. The plasma parameters analysis shows that a dense plasma is formed during pulsed discharges in hydrogen at pressures of 400 atm and currents of about 65 ka. This plasma has a charged particle density of about 10^{19} cw^{-3} and a temperature of about 18,000 ^{o}K. Typical pulse wave forms and dynamic volt-ampere characteristics of the discharge are also shown.

Beylis, I. I., G. A. Lyubimov, and V. I. Rakhovskiy. Diffusion model for the cathode region of a high-current arc discharge. DAN SSSR, v. 203, no. 1, 1972, 71-74.

A steady-state arc discharge in a copper electrode vapor is examined. An analysis of electron beam relaxation highlights the processes of shock and thermal ionization, as well as electron beam scattering in coulomb collisions. Preliminary analysis of a series of mathematical equations shows that, as a function of I, ξ, and S values (arc current, cathode ablation and fractional electron current), the electron temperature can change from a value equal to the cathode temperature (~0.5ev) to values up to 3 - 4 ev. The upper temperature limit is determined by the "tail" electron energy loss of the Maxwell distribution. At an electron temperature $T_e \gtrsim 3$ ev, it is necessary to consider the plasma electron current component in the current balance on the cathode surface. At $\xi = 1$, a segment of the electron current can be less than half and a minimum value is determined from the relation $S_{min}/(1 - S_{min}) = U_i/U_c$, where U_i is the atom single ionization potential and U_c is the beam energy. Ion flow at the walls is determined by the diffusion and the thermal ionization rate. When the gradients in the cathode regions are small and the ion temperature is $T_i \cong 1/4\ n_i v_i$ (where n_i is the ionization level), it is possible to define n_i using the remaining equations. The solution of the system of equations is highly critical with regard to values of charged particle concentration and the degree of ionization.

Teoriya uskoriteley (Theories of accelerators). Moskva, 1971, 140p. (RZhF, 5/72, no. 5A383 K) (Translation)

This is a collection of eight papers on theoretical problems of the interaction of charge and particle bunches with accelerator structures, the radiation stability of electron rings, and the theory of the automatic control of trajectories and betatron oscillations in circular accelerators.

Dubrovin, V. M., A. D. Lebedev, B. A. Uryukov, and A. E. Fridberg. Electric arc in an immersed gas jet. ZhPMTF, no. 5, 1971, 17-23.

The properties and behavior of an arc burning in a free gas were investigated in an installation providing an immersed jet with a 0.5-4% turbulence level in a 10 - 300 m/sec velocity range. An electric arc was ignited on the axis of the jet. Specifically, the behavior of the arc in an immersed jet, its stability with respect to the flow axis, and its instability were considered. Slow-motion photography, high-speed photography of the transverse arc oscillations using streak-camera scanning, still photography, and shadow still photography were used, as well as shadow motion photography with light provided by a gas laser source.

It was shown that an arc will burn steadily in a low-turbulence jet. Shadow photographs revealed a thermal layer boundary near the arc layer in which an acute density change of the medium occurs. At velocities up to about 20 m/sec, the arc-layer boundary constitutes a smooth monotonic curve. With increasing velocity the boundary becomes

periodically more turbulent. At some distance from the nozzle cutoff, pronounced mixing of the arc layer gas mass with the surrounding medium occurs. The process has an "explosive" nature, and is evidently a consequence of arc layer interaction with the jet turbulent region. At a further distance from the arc origin, the arc column undergoes chaotic oscillations. The points of arc-layer destruction and initiation of turbulent arc oscillations approach one another as the velocity increases. This is shown in Fig. 1, by the values of x_0' and x_0. These values are

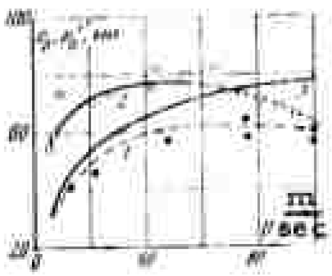


Fig. 1. Experimental and theoretical characteristics of arc-layer destruction

the distances from the nozzle cutoff to the indicated points (curves 1 and 2 are the experimental values of x_0' and x_0, respectively; curve 3 is the theoretical value of x_0). Theoretical solutions agreed well with experimental arc-layer boundary data. Experimental values of the arc laminar zone length, the thermal arc layer radius and the electric field intensity were in good agreement with calculations.

Karchevskiy, A. I., and Yu. I. Strakhov
Thresholds of beam current instability in a direct discharge. ZhETF P, v. 13, no. 11, 1971, 595-599.

In a beam discharge in plasma, the excitation of the anomalous resistance R was investigated as a function of the initial plasma density n_{eo} and voltage condenser charging voltage U_o. Parameters of the discharge device were: current to 30 ka, pulse width - 1.6 μsec, capacitance - 0.2μf (50 kv), current channel cross-section ≅ 80 cm^2, and initial plasma density n_{eo} - 1.10^{12} to $3.10^{13}/cm^3$. The discharge was obtained in a uniform magnetic field with electrode spacing of 5 or 28 cm. The electron beam was withdrawn from the gas discharge through a latticed anode and its propagation along the magnetic field in a uniform-potential plasma-filled space was studied. Beam current density and electron energy were measured at 20 cm from the anode together with the x-ray bremsstrahlung from the target. Electron beam parameters were: total current to 25 ka, electron energy to 30 kv, beam duration 0.2 ~1.5 μsec, and beam cross-section ~100 cm^2. At lower plasma densities $n_{eo} < 10^{13}/cw^3$, the plasma gap resistance R significantly exceeded the wave resistance of the network Z wave = 1.2 Ω (an aperiodic discharge). Initial plasma density n_{eo} and discharge voltage were the controlling parameters in the aperiodic regime, and discharge current was supplied by the plasma resistance. At higher plasma densities $n_{eo} > 10^{13}/cm^3$ and plasma resistance R <Zwave (an oscillating discharge), the controlling parameter in the discharge was the discharge current.

Relationships were plotted for R as a function of the discharge voltage U_r and current I_r at the critical current density j_{cr}, which has a linear relationship with n_{eo}. The intensity of the x-ray radiation burst J_x varied with changes in U_r and I_r. X-ray radiation energy was determined by a photographic dosimetry method and a photomultiplier, the results of which were 9.0 ± 1.0 kev and 10.5 ± 1.5 kev respectively. Correlation of the results from the two methods and other data verified the fact that the energy dissipated by the anomalous resistance R is lost in electron acceleration and is conducted through the accelerated electron beam anode. In a direct discharge when n_{eo} is increased from 10^{12} to $2.5 \times 10^{13}/cm^3$, current instability is excited at an electron drift velocity close to thermal. A significant portion of energy (20-80%) is expanded during the brief time interval of 0.2 - 1.5 μsec in the generation a powerful pulsed electron beam.

Tsytovich, V. N. and A. S. Chikhachev.
Structure of power-law spectra of relativistic electrons in a turbulent plasma.
IN: Sbornik. Fizika plazmiy, no. 3, Moskva, Atomizdat, 1971, 97-103. (RZhF, 5/72, no. 5G156) (Translation)

A self-consistent problem is investigated on the spectrum of electrons and electromagnetic waves in a turbulent plasma. It is shown that the particle spectrum normally cannot be described by the power law, but can be by a law that is close to it.

Krishtal, M. A., L. I. Ivanov, and V. V. Ryazantseva. Effect of electron irradiation on the hardening of steel. MiTOM, no. 5, 1972, 52-53.

The hardening effects of electron irradiation, leading to the generation of vacancies and interphase atoms was investigated. These defects appear highly pure form in steel. Investigations were made with < 2 mm steel disc specimens (Fig. 1). Heating and

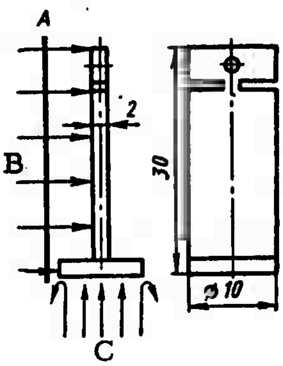


Fig. 1. Experimental diagram
A - titanium foil; B - electron flux; C - water

tempering of the specimens was performed in an upward-moving electric furnace with attachments for face tempering. The specimens were heated to ~900°C and irradiated by electrons for 3 minutes at an average flux intensity of 5.10^{13} el/cm^2 sec. An instantaneous concentration of Frenkel pairs formed during tempering at approximately 10^{-9} pair/sec. The hardness was measured along the specimen length and the microstructure was examined. Comparative hardness values for U10 and S-50 steels after normal and electron irradiation tempering are shown in Fig. 2. Conclusions are: 1) Steel hardening increases

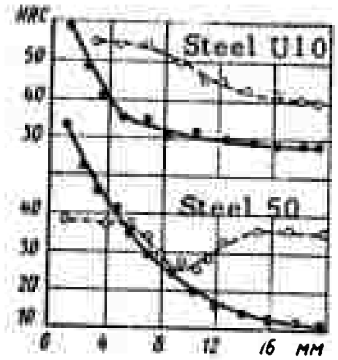


Fig. 2. Hardness of steel over
the specimen length.
——— normal tempering (thick line)
——— tempering + irradiation (thin line)

significantly after irradiation by relativistic electrons at equilibrium temperatures of austenite and in the specimen cooling process. 2) Sufficiently stable paired vacancies are formed, namely carbon atoms from excess vacancies with radiative natures, together with interstitial carbon atoms, which facilitates the stabilization of austenite. 3) The vacancies formed during plastic deformation of austenite also increase the steel hardening.

Mel'nik, V. I., and A. A. Novikov. <u>Gas discharge electron source in the form of a high-voltage glow discharge for thermal processing of materials.</u> EOM, no. 1, 1972, 84-88.

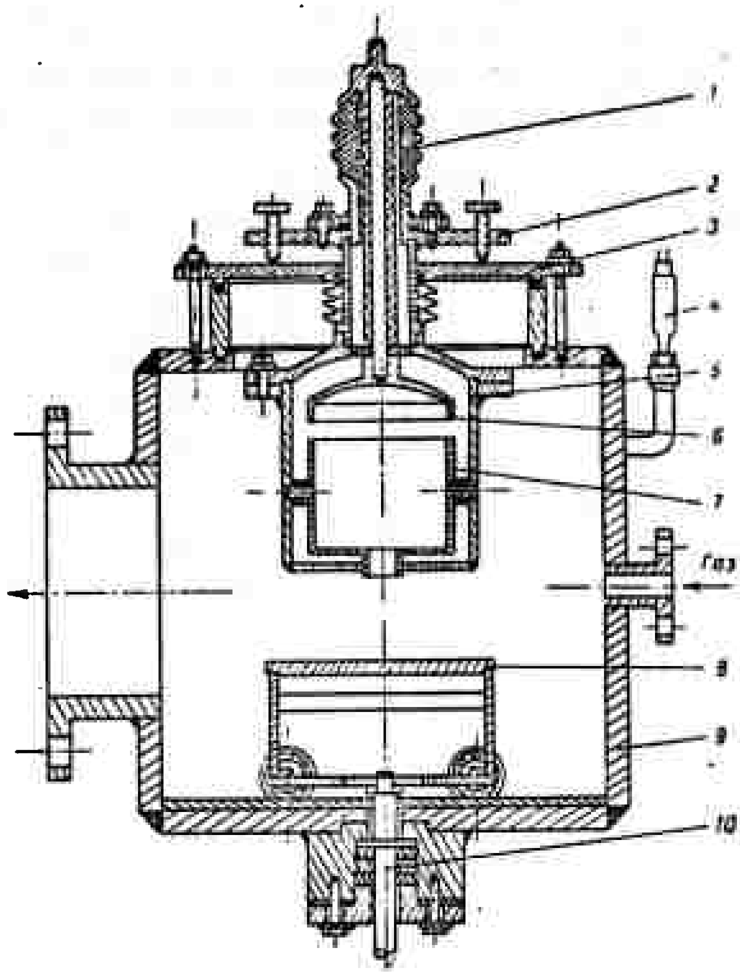


Fig. 1. Working chamber and gas discharge electron source. 1 - high voltage, 2 - adjusting device, 3 - flange, 4 - manometer, 5 - anode, 6 - cathode, 7 - control electrode, 8 - sliding table, 9 - vacuum chamber, 10 - drive for shifting specimens.

Development and testing are discussed of a controlled electron beam thermal source in the form of a high-voltage glow discharge for synthesizing and sintering refractory materials under laboratory conditions. Two gas discharge electron source configurations are described, and one of the configurations is shown in Fig. 1. The sources were fed by a 10 kv rectifier. The control electrode circuit and the focusing magnetic lens were supplied by a UIP-2 rectifier, and the electron source anode was grounded. The working chamber was mounted on a general purpose high vacuum device, and the required vacuum pressure of $10^{-1} - 5 \cdot 10^{-3}$ torr was maintained by a forevacuum pump. The fraction of energy liberated on the components was 70-80% of that consumed by the source, the control energy was about 1%, and the remainder was distributed approximately equally between the cathode and the anode. The electron beam diameter without magnetic focusing was 3-4 mm, and the specific power was up to $10^8/m^2$. A negative potential with respect to the anode up to 200 v, was applied to the control electrode since at higher negative potentials electron beam defocusing and intensive heating of the control electrode occurs. Using the described electron sources, sintering tests were carried out on lanthanum hexaboride, as well as welding tests on thin layers of steel in a residual gas atmosphere of the selective vacuum system at 10^{-1} torr; the results of both tests were satisfactory.

B. Recent Selections

Abramyan, Ye. A. Charged particle accelerator. Author's certificate, USSR no. 316399, published March 23, 1970, Otkr izobr, no. 36, 1971, 220.

Abramyan, Ye. A., S. B. Vasserman, V. M. Dolgushin, O. P. Pecherskiy, and V. A. Tsukerman. Pulsed charged particle accelerator. Author's certificate, USSR no. 304895, published July 23, 1968, Otkr izobr, no. 36, 1971, 220.

Agafonov, A. V., and A. N. Lebedev. Theory of gas focusing of a powerful electron beam. ZhTF, no. 7, 1972, 1432-1436.

Akkerman, A. F., V. A. Botvin, and Yu. M. Nikitushev. Distribution by depth of defects and absorbed energy in silicon, due to electron energies to 6 Mev. IN: Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 1, 1971, 298-305. (LZhS, 30/72, no. 98235)

Aref'yev, V. I., S. D. Grishin, and L. A. Kuz'min. Effect of a constant magnetic field on an inductive discharge. TVT, no. 4, 1972, 689-692.

Aronov, B. I., and A. A. Rukhadze. Energy flow of e-m radiation during beam instability development in a magnetized plasma. ZhTF, no. 8, 1972, 1606-1609.

Babich, L. P., and Yu. L. Stankevich. Criteria for transition from a gas discharge streamer mechanism to continuous electron acceleration. ZhTF, no. 8, 1972, 1669-1673.

Basman, A. R., A. B. Gerasimov, N. D. Dolidze, et al. Isothermic annealing of radiation defects in Ge, irradiated by fast electrons at $T = 77^{\circ}K$. Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 1, 1971, 207-210. (LZhS, 30/72, no. 98326)

Bichkov, Yu. I., P. A. Gavrilyuk, and Yu. D. Korolev. Investigating discharge development in nanosecond range under atmospheric conditions. 10th Int. Conf. Phenomena of Ioniz. Gases, Oxford, 1971. Contrib. paper. Oxford, 1971, 168. (RZhMekh, 8/72, no. 8B167).

Bobylev, V. I., A. M. Kozodayev, N. V. Lazarev, V. S. Skachkov, and Yu. B. Stasevich. High-voltage thyristor generator of powerful pulsed current. PTE, no. 4, 1972, 103-106.

Balotin, L. I., Ye. A. Kornilov, O. K. Nazarenko, S. K. Pats'ora, and Ya. B. Faynberg. Instability of electron welding beams. ZhTF, no. 8, 1972, 1620-1624.

Burtsev, V. A., V. N. Litunovskiy, and M. P. Nadgornaya. Investigating coaxial plasma accelerator with uniform gas pressure distribution in the interelectrode gap. ZhTF, no. 8, 1972, 1706-1714.

Bychkov, Yu. I., Yu. D. Korolev, and P. A. Gavrilyuk. Formation of discharge and highly-conductive channel from nanosecond electric discharge. ZhTF, no. 8, 1972, 1674-1680.

Danilov, V. N. Quasi-one-dimensional solution to equations for a high-current electron beam. ZhPMTF, no. 4, 1972, 47-56.

Dashchenko, A. I., E. P. Stakhno, and A. I. Imre. Detection of emission during electron-ion collisions in intersecting beams. PTE, no. 4, 1972, 196-198.

Deryugin, G. M., and I. A. Shukeylo. Calculating the limiting current in large cyclic accelerators and storage elements. ZhTF, no. 8, 1972, 1629-1631.

Didenko, A. N., A. P. Privezentsev, and G. P. Fomenko. Influence of pulse cut-off effect instability on the operation of cyclic accelerators. ZhTF, no. 8, 1972, 1632-1638.

Gabovich, M. D., I. A. Soloshenko, and L. S. Simonenko. Plasma electron capture by an ion beam wave field. UFZh, no. 8, 1972, 1362-1364.

Gerasimenko, N. N., L. V. Lezheyko, Yu. A. Litvin, and L. S. Smirnov. Irradiation of artificial diamonds by fast electrons. Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 1, 1971, 339-345. (LZhS, 30/72, no. 98400)

Gertsev, K. F., A. D. Yermolayev, and V. I. Zaytsev. Synchronization of a beam injection system into a proton synchrotron by an injector beam. PTE, no. 4, 1972, 17-18.

Ginzburg, V. L. Electron accelerator with laser undulator as an x-ray source. KSpF, no. 2, 1972, 40-44. (LZhS, 32/72, no. 105180)

Golubev, Ye. M., N. N. Ogurtsova, I. V. Podmoshchenskiy, and P. N. Rogovtsev. Experimental investigation of the instability of a heavy-current discharge in an open tube. TVT, no. 4, 1972, 724-727.

Gontarev, G. G., L. M. Blinov, V. V. Volod'ko, G. V. Lysov, A. T. Zamorenov, and A. V. Trukhin. H_{10} wave SHF-plasmatron. Author's certificate, USSR no. 231037, published September 20, 1967. Otkr izobr, no. 26, 1972, 190.

Gurevich, A. V., L. V. Pariyskaya, and L. P. Pitayevskiy. Ion acceleration during rarefied plasma expansion. ZhETF, v. 63, no. 2, 1972, 516-531.

Kikvidze, R. R., V. G. Kotetishvili, and A. A. Rukhadze. Discharge emission from a solid plasma during beam instability development. FTT, no. 8, 1972, 2231-2235.

Kirdyashev, K. P., and A. N. Zaikina. Investigation of SHF-wave dispersion in a plasma-beam discharge. RiE, no. 9, 1972, 1873-1879.

Komar, Ye. G. Method of accelerating positively charged particles. Author's certificate, USSR no. 286808, published June 28, 1968. Otkr izobr, no. 36, 1971, 220.

Komkov, V. S., G. M. Pateyuk, A. A. Chernoyvan, and T. V. Khorsun. Ion acceleration in a plasma boundary layer formed by two electron groups. IVUZ Fiz, no. 8, 1972, 111-113.

Krivov, M. A., V. N. Brudnyy, S. V. Malyanov, et al. Effect of electron (1.5 Mev) and proton (5 Mev) irradiation on electrical, optical and photo-electrical characteristics of gallium arsenide. Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 2, 1972, 16-21. (LZhS, 32/72, no. 105164)

Kubarev, Yu. V., M. A. Krasnenkov, S. I. Korshakovskiy, and I. M. Matusevich. Probe for measuring local parameters of ionized gas flow. TVT, no. 4, 1972, 885-887.

Kumakhov, M. A. Spatial distribution of radiation defects and interstitial ions in crystals, irradiated by fast ions. Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 1, 1971, 132-142. (LZhS, 30/72, no. 98369)

Mamedov, R. A., N. A. Ukhin, V. M. Ryazanskiy, and K. B. Vasil'yev. Investigating semiconductor devices in linear electron accelerators. Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 2, 1971, 200-205. (LZhS, 32/72, no. 106324)

Martynyuk, M. M., O. G. Panteleychuk, and V. I. Tsapkov. Melting of metallic wires by powerful current pulses. ZhPMTF, no. 4, 1972, 108-112.

Mesyats, G. A., and Ye. A. Litvinov. Volt-ampere characteristics of a diode with a point cathode in an explosive regime of electron emission. IVUZ Fiz., no. 8, 1972, 158-160.

Mkheidze, G. P., M. D. Rayzer, M. S. Rabinovich, and A. A. Rukhadze. Feasibility of building 20 to 50 Mev pulsed electron accelerators. KSpF, no. 3, 1972, 67-74.

Moroz, Ye. M., V. Ye. Pisarev, and N. S. Solov'yev. Accelerator tube. Author's certificate, USSR, no. 308695, published May 25, 1970. Otkr izobr, no. 36, 1971, 220.

Rayzer, M. D. Transient effects during heavy-current electron beam generation. ZhTF, no. 8, 1972, 1639-1642.

Rudenko, N. S., and V. I. Smetanin. Electrical breakdown of large gaps in neon at pre-ionization conditions. ZhETF, v. 63, no. 2, 1972, 491-497.

Spitsyn, A. V., G. M. Gasumov, and A. K. Abiyev. Comparing results of electron irradiation of germanium at 1 and 28 Mev. IAN Az, Ser. Fiz-tekh. i mat. nauk., no. 1, 1972, 142-149.

Ukhin, N. A., and A. K. Abiyev. Characteristics of 28 Mev electron irradiation of germanium at liquid nitrogen temperature. Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 1, 1971, 202-207. (LZhS, 30/72, no. 98462)

Uryukov, B. A., and A. E. Fridberg. Limit estimates of electrical characteristics of an arc discharge. IAN SO, Ser. tekh. nauk, v. 8, no. 2, 1972, 3-6.

Uvarov, Ye. F., and M. V. Chukichev. Study of radiation defects in commercial silicon, irradiated by 1 Mev electrons. Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 1, 1971, 305-312. (LZhS, 30/72, no. 98455)

Vekhov, A. A., F. A. Nikolayev, and V. B. Rozanov. Investigating space-time distribution of optical plasma density in Li and In heavy-current discharges. TVT, no. 4, 1972, 728-731.

Vyatskin, A. Ya., A. N. Kabanov, and V. V. Trunev. Transmission, reflection and absorption of powerful electron beams in thin films of various metals and alloys. RiE, no. 9, 1972, 1893-1898.

Vyatskin, A. Ya., and V. V. Trunev. Interaction of electrons with dielectric thin films. RiE, no. 9, 1972, 1899-1905.

Yegorov, N. V., V. I. Il'in, and G. N. Fursey. Device for studying pulsed field emission. PTE, no. 4, 1972, 157-160.

Zeydlits, V. P., and A. K. Berezin. Investigating frequency spectrum dynamics of plasma-beam discharge oscillations. UFZh, no. 8, 1972, 1366-1369.

Zharov, V. F., V. K. Malinovskiy, Yu. S. Neganov, and G. M. Chumak. Effectiveness of relativistic electron beam excitation of an $F_2 + H_2$ laser. ZhETF P, v. 16, no. 4, 1972, 219-222.

5. Material Science

A. Abstracts

Andreyev, V. G. and P. I. Ulyakov. Finite dimension volumetric thermal shock in a transparent plate. I-FZh, v. 23, no. 1, 1972, 158-159.

The presence of high temperature gradients during a short-termthermal shock requires the application of a hyperbolic equation of thermal conductivity, which takes into account the finite heat propagation velocity (HPV). In dielectrics, the thermal conductivity of the lattice is the basic mechanism of heat transfer, and the HPV equals the velocity of sound c_0 in the medium. The movement of temperature and stress perturbations with equal velocity along a material signifies the propagation of a single wave. When the given initial conditions are discrete (instantaneous shock), the pressure, amplitude, and density in such a wave undergo a shock, and equations of thermal elasticity are inapplicable for finding the parameters of the medium during a rupture of its continuity.

In real processes, thermal shock has a finite duration and stress accretion takes place continuously behind the wave leading edge. In the present work, the solution of the dynamic problem of thermal elasticity for a three-dimensional shock of finite duration is obtained by the method of Laplace transforms. Expressions are obtained for the temperatures and stresses, and the problem is solved in parallel with the parabolic equation of thermal conductivity. The quasi-static stressed state is a particular case (when $c_0 \to \infty$). Introducing heat-propagation velocity equal to sound velocity into the thermoelasticity problem eliminates the physically contradictory appearance of stresses prior to wave arrival at a given point. Analysis shows that the amplitude of the temperature front attenuates exponentially with time and does not affect the stress wave motion. After passage of the elastic-wave front, a field of quasi-static stresses is established.

Gashchenko, A. G. <u>Statistical aspects of thermal stability of refractory materials</u>. Problemy prochnosti, no. 5, 1972, 79-82.

On the basis of test data on 60 corundum and 50 zirconium dioxide specimens, it was confirmed that the dispersion of destructive temperature differentials, which characterize the thermal resistance of refractory ceramic materials, is subject to the Weibull distribution. The variance of destructive temperature differential values under identical conditions of thermal loading (Q = const) is higher than the variance of the limit stress values for mechanical loading, and the parameters M in the corresponding distributions may differ significantly. It was found that when investigating ceramic refractory materials, it is preferable to define the parameter m' on the basis of

$$m' = \frac{d_n}{D^*(\lg X)\,2.3059}.$$

Here d_n is dependent on the number of test specimens; $D^*(\lg X) = \sqrt{D'(\lg X)}$, where $D'(\lg X)$ is the unbiased value dispersion of the logarithm of random value x. This expression most completely depicts the influence of the statistical aspects of the breakdown kinetics.

Tret'yachenko, G. N. and V. K. Fedchuk. Device for investigating destruction of structural elements in supersonic high temperature gas flow containing a controlled amount of abrasive particles. Problemy prochnosti, no. 5, 1972, 112-113.

On the basis of the gas-dynamic test stand of Pisarenko, et al (IN: Termoprochnost' materialov i konstruktivnykh elementov, Kiyev, 1965), a device was developed for studying the destruction processes of aircraft thermal-protection materials and elements, and flow-through parts of high-temperature machines, simulating operational conditions. By means of this device, it is possible to investigate: (1) destruction and crack formation factors in nozzle-insert materials and heat insulation from an unstable thermal stress state, (2) heat-insulation structures, and (3) the effect of gas flow corrosion-erosion action on the process of nozzle-insert breakdown. The device is capable of producing a stream with a temperature T = 1950° K, a velocity of 1160 m/sec, and a flow rate of up to 1 kg/sec.

The apparatus consists of a sectional supersonic nozzle, a high-temperature combustion chamber, two cooling units, a controlled injector of abrasive particles into the gas stream, and measuring and recording instrumentation. The nozzle consists of three sections: subsonic, critical, and supersonic, fitted together into a single unit. Heat-insulation materials can therefore be tested in a supersonic gas stream, and, by replacement of the critical section with a special chamber, nozzle-insert model specimens can also be tested. The specimen insert is placed in a test chamber, in the form of a metal sheath filled with soot for heat insulation. In addition, high-temperature insulation is provided by a MgO layer. The high-temperature oxygen combustion chamber raises the stream temperature to about 2700° K. Compressed air is supplied at 2-3 atm to a

hopper containing the abrasive, which is fed through a screened rotor into a nozzle for injection into the combustion chamber. The abrasive transfer to the nozzle is regulated by the rotor rate.

Device specifications conform to the gas-flow parameters of the basic gas-dynamic test stand: gas consumption, 517 g/sec; fuel consumption, 60 g/sec; oxygen consumption, 100 g/sec; supersonic nozzle entry temperature, 2500° K; pressure, 3 atm, and pressure behind the nozzle, 1 atm. The Laval nozzle has a critical cross section of 33.6 cm^2 (the diameter is correspondingly 65 mm) and an expanding section length of 170 mm, which with an aperture of $2\alpha = 20^{\circ}$ controls the outlet diameter of 125 mm. Preliminary tests confirmed the feasibility of the following gas-flow parameters: temperature - 1950° K, and velocity - 1160 m/sec, which corresponds to the Mach number M = 1.22.

Rodichev, Yu. M. Factors of weakening of sheet asbotextolite under intense unilateral heating. Problemy prochnosti, no. 5, 1972, 51-53.

Weakening factors of asbotextolite protective coatings were studied at a linear surface temperature increase of the carrier layer, observed during the heating of aerodynamic structures. The tests were conducted on an installation for studying the mechanical properties of heat-resistant plastics under conditions of programmed intensive unilateral heating during bending. Heat was applied by contact using a thin nickel resistance heater. Load application was by flexure. The specimen surface was heated at constant rates of 0.5, 1, 2, and 4°/sec.

The sheet asbotextolite test specimens were 180 mm long and had a thickness (equal to $h_{(\tau)}$ for the carrier layer) of 10 to 52 mm. Flexure loading of the specimens took place when surface $T^* = 1323^\circ$ K. The heating time, determined by the heating rate, was 2100, 1050, 525, and 262.5 sec, respectively. Fig. 1 illustrates experimental data on temperature distribution with respect to thickness of the asbotextolite specimens at the instant of loading.

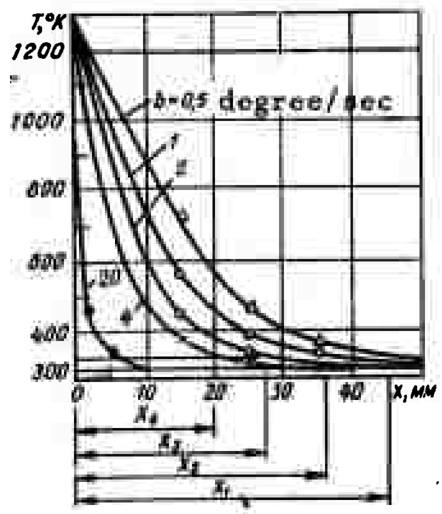


Fig. 1. X_1, X_2, X_3, X_4, -- Materials heating depth of the carrier layer at varying heating rates.

The higher the rate of temperature rise, the greater is the specimen bending strength (Fig. 2). The current thickness of the

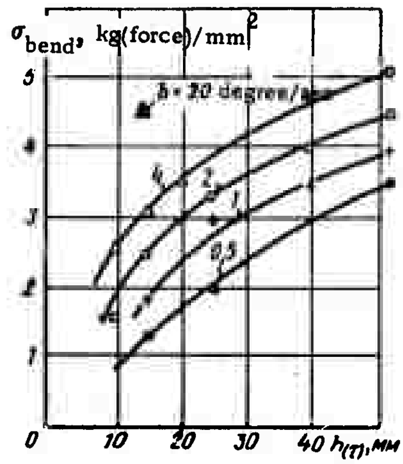


Fig. 2. Bending-strength limit in relation to heating rate and thickness of asbotextolite carrier layer.

carrier layer $h_{(\tau)}$ of coking asbotextolite during unilateral high-temperature heating is also a characteristic factor of its bending strength. With an increase of $h_{(\tau)}$ from 10 to 52 mm, the bending strength limit almost doubles. The greater the specimen thickness, the less is the effect of the heating rate.

These tendencies are a result of an increase in the relative thickness of the carrier layer $\frac{h_{(\tau)}}{X_{(\tau)}}$, where $X_{(\tau)}$ is the heating depth of the carrier layer. Correlation of the obtained characteristics to the value of a Fourier criterion Fo*, which determines the temperature distribution in the carrier layer of the material at the instant of loading under a linear law of temperature change on a heated surface (where a_O

$$Fo^* = \frac{a_0 \tau^*}{h^2_{(\tau)}}, \quad \text{or } Fo^* = \frac{a_0 (T^* - T_0)}{b h^2_{(\tau)}},$$

is the coefficient of temperature conductivity at $T_O = 293^\circ$ K, τ^* is the heating duration, and b is the temperature rise rate on the surface of the carrying portion) permits a relationship to be established between $F_O{}^*$ and σ_{bend} (the bending strength of the asbotextolite sheet). The required initial thickness of the protective covering can be determined using this relationship and taking the aerodynamic heating conditions into account.

Udovskiy, A. L., N. O. Gusman, and V. N. Barabanov. Effect of test temperature on the energy of destruction of graphite. Problemy prochnosti, no. 5, 1972, 83-84.

To assess the effect of test temperature upon local characteristics of the energy of destruction, bending tests were conducted on specimens of fine-grain, homogeneous 8 x 8 x 40 mm graphite. The graphite was mechanically practically isotropic. The intensity of the elastic deformation energy release (the destruction ductility) was determined within the temperature range 20° to 2000^0 C. A lateral crack was simulated in each specimen by incision with a fret saw and tapering with a razor blade. The experiment was conducted on a test machine equipped with a low-lag resistance furnace. The high-temperature tests were conducted in an argon atmosphere. In the first stage of operation, at 20° C, the relationship of destruction ductility G to the relative incision size c/d was determined. More than 90 specimens were tested under conditions of

pure flexure. Destruction occurred with negligible brittleness. Load-deflection diagrams were automatically recorded on a two-coordinate potentiometer, and the value of G was computed. In the second stage, tests were conducted at 2000° C. It was found that, at both temperatures within the c/d range from about 0.2 to 0.4, the values of G are invariable and are not a function of the incision depth. G becomes constant at these values of relative incision depth over the entire temperature range from 20 to 2000° C.

Two series of c/d = 0.2 and 0.3 specimens were tested at 500, 1000, 1400, 1800, and 2300° C. Results were used to plot the relationship of the energy of destruction to the test temperature, under the assumption that the critical value of G, $G_c = 2\gamma_{eff}$ (Fig. 1).

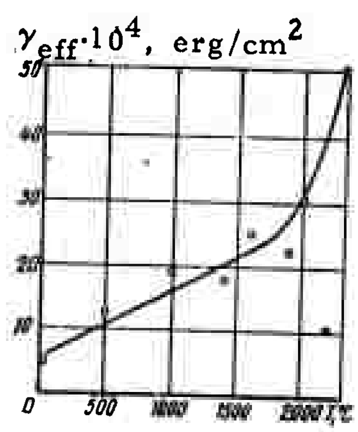


Fig. 1. Destruction energy vs. test temperature.

It was experimentally established that at temperatures of 2000-2300° C the values of γ_{eff} exceed those at 20° C by an order of magnitude. Such a rise in the energy of destruction with an increase of the test temperature is caused by an increase of energy dissipation for plastic deformation at the crack terminus.

Motulevich, V. P., Yu. N. Vorontsov, and V. M. Yeroshenko. Combustion of carbon particles in supersonic flow of a chemically active gas. FGiV, no. 3, 1971, 345-352.

The approximate method of relative correspondence of Motulevich (IFZh, v. 14, no. 1, 1968) is used to evaluate the surface ablation rate on a body purified by a chemically active gas. To check the theoretical relationships of the process, experiments were conducted in a supersonic wind tunnel. Carbon rod models were placed between the nozzle and a cylindrical diffuser 3-4 mm from the nozzle cutoff. The mainstream parameters were: Mach number M = 2.72-3.03, stagnation temperature T_{00} = 1100-1300° K, stagnation pressure p_{∞} = 1.86-2.24 x 10^5 newtons/m^2. The model shapes were a cylinder, a hemisphere-cylinder, and a cone-cylinder. The material nominal density was 1.54 g/cm^3. The model diameter was d = 4-8 mm and relative length was $\overline{l}$ = 6 mm. The modal configuration changes and the surface brightness temperature were measured by photopyrometry. The characteristic wavelength was λ_{eff} = 0.66 microns; the gas was assumed to be optically transparent. The accuracy of temperature measurement was to within ± 4%. When processing the experimental results, it was assumed that the chemical reaction takes place only on the surface within the observed surface-temperature range (1600-2400° K) according to the system:

$$2C+O_2 \rightleftharpoons 2CO.$$

As a result of particle interaction with the flow, the axisymmetric models acquired a shape that can be approximated by an ellipsoid of revolution with the characteristic dimension a = 0.13-2.0. The absolute temperature values near the forward critical point are presented in Table 1.

k_∞	T_{w0}, °K	β, g cm⁻²·sec⁻¹	b, g·cm⁻²·sec⁻¹
0,23	1720—1820	0,080—0,120	0,187—0,225
1,0	2050—2250	2,066—0,100	0,39—1,05

Table 1.

Fig. 1 shows that the rate of particle surface change during combustion

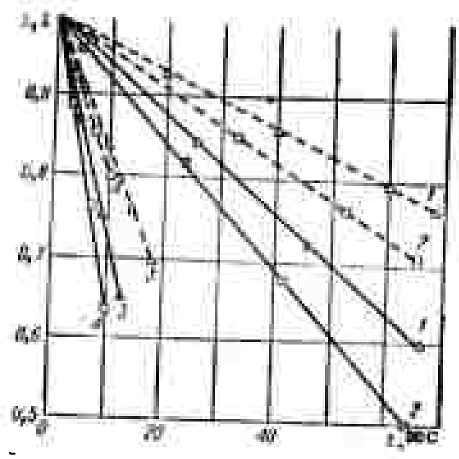


Fig. 1. Change of the relative surface area $\bar{S} = \frac{S}{S_O}$ (S, S_O are the current and initial values of the model surface area) and the relative length of the model $\bar{l} = \frac{l}{l_O}$ (dotted line) in the combustion process. $k_\infty = 0.23$: 1 - $\bar{a} = 0.3$; 2 - $\bar{a} = 0.7$. $k_\infty \approx 1.00$: 3 - $\bar{a} = 0.2$; 4 - $\bar{a} = 1.4 \div 1.47$.

is linear, irrespective of the value of $\bar{a}$. The mass removal rate at the critical point is also linear. Fig. 2 shows the characteristic experimental

relationships of the mass removal rate from the entire model surface area. The relationship of the total mass removal rate m to the removal rate at the critical point m_O indicates that in the air stream for a particle with $\bar{a} = 0.3$ the ratio $\frac{m_O}{m} = 4.35$, while for $\bar{a} = 0.70$ the ratio is $\frac{m_O}{m} \approx 6.0$. For all configurations, mass removal at the rear zone of the models is insignificant. Comparison of the values of β and b from Table 1 reveals that the fundamental role in heat exchange during particle combustion in oxygen flow is that of diffusion resistance (Kritrin, FGiV, 1957) characterized by the term $1/\beta$.

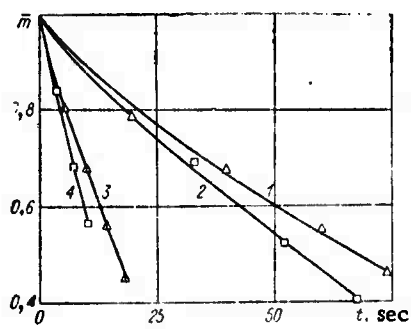


Fig. 2. Mass removal rate vs. time. Curve parameters are those of Fig. 1.

The mechanism of relative correspondence was therefore used to obtain very simple relationships which permit evaluation of the substance removal rate from the surface of a body in the stream of a chemically active gas in the presence of a heterogeneous chemical reaction. Mass removal rates from carbon particles of differing configuration were established from experimental data, and it was determined that the mass removal rate at the critical point and the surface change rate of a burning particle are constant. The temperature differential between the front and rear deges of the particle was also evaluated. It is shown that mass-removal data calculated by the method of correspondence are in satisfactory agreement with experimental data.

Rabinovich, L. B. and G. N. Sechenov.
Heat transfer conditions from a surface to a fluidized layer under pressure.
I-FZh, v. 22, no. 5, 1972, 789-794.

The effect of temperature, pressure, and gas composition on surface heat transfer to a contiguous fluidized layer was studied within the temperature interval 150 to 1000° C and at pressures from 0.5 to 30 atm. The test facility consisted of a device for investigating heat exchange in a fluidized layer, comprising an externally heated electric furnace, a tubular cooler, a carrier-gas heater, and control and measurement instrumentation. Two units were used: one for heating the wall temperature to 100 to 400° C at up to 50 atm; the other for heating from 400 to 1000° C, to the same pressure. The wall temperature of the external apparatus was maintained at a constant level in each series of experiments. In the initial mixture, gas was coupled with a pulverized catalyst, using particle sizes of 0.40 - 1.0 mm.

Used as the fluidizing gas composition were an equal mixture of nitrogen and CO_2, and two mixtures of nitrogen, H_2 and CO_2: (a) CO_2 16%, N_2 55%, H_2 29%, and (b) CO_2 25-30%, N_2 35%, H_2 35-40%.

As the pressure was increased from 0 to 30 atm (i.e., with increasing gas flow G, kg/h) within the 120 to 260° C range, and other conditions being equal, the heat-exchange coefficient α increased, despite a decrease of the gas linear velocity. The maximum value of α was not attained in the investigated range of pressures and temperatures, since the experiments were conducted at relatively low gas-stream velocities within the ascending curve of $\alpha = f(G, P)$ where P = internal pressure.

The value of α is definitely affected by the gas physical properties. Experimental results show that the greater the H_2 content the higher is the α, particularly with regard to the process of methane vapor conversion; α rises with increased temperature. With a mean temperature rise in the layer from 300 to 900° C, the absolute value of α_{tot} increases by a factor of 2.4-2.7. The relationship of the rise of α with increased pressure is valid at each temperature layer. At temperatures above 300° C, the increase of the difference between the apparatus surface temperature and the mean layer temperature becomes more pronounced. Data obtained during investigation of the surface heat transfer to a fluidized layer, with nitrogen as the carrier gas, were generalized by the relationship Nu = f(Re). An equation for calculation of the total (convective and radiative) heat transfer coefficient was derived on the basis of the experimental data:

$$Nu = 42.17\, Re^{0.9}\, T_{layer}/250,$$

where T_{layer} is the mean temperature of the fluidized layer; 250° C is the lowest value of T_{layer} adopted in the calculation of α.

Andreyev, Yu. P., Ye. V. Gusev, and I. A. Semiokhin. Equilibrium in nitrogen-oxygen mixtures at high temperatures. ZhFKh, v. 46, no. 6, 1430-1432.

Equilibrium in nitrogen-oxygen mixtures within the temperature range 298 to 20,000° K is considered to evaluate the processes occurring in these mixtures in a pulse-discharge plasma. The investigation deals with two mixture ratios: $N_2:O_2 = 1:1$ (equimolecular mixture), and $N_2:O_2 = 4:1$ (air). The equilibrium was calculated for pressures which permit the operation of xenon flashlamps in an admixture of nitrogen and oxygen (760 torr) or in pure mixtures of nitrogen and oxygen (50 torr).

Temperature relationships of the equilibrium concentrations (in terms of mole fractions) of nitrogen-oxygen plasma products within the indicated range were calculated for $N_2:O_2 = 1:1$, 760 torr; $N_2:O_2 = 1:1$, 50 torr; $N_2:O_2 = 4:1$, 760 torr; and $N_2:O_2 = 4:1$, 50 torr. Curves of N_2, O_2, NO, O, N^+, O^+, and e were plotted for the initial mixtures and pressures. The curves show that as the temperature increases, the equilibrium-concentration curves of NO, N, and O pass through a maximum. The position of the maxima on these curves is virtually independent of the mixture composition, but the maxima shift toward higher temperatures as the pressure rises. The absolute value of the equilibrium product-concentration maxima is also a function of pressure. The maximum value of the equilibrium concentration of NO consequently rises with pressure. At concentrations of about 10^{-2} mole fraction, O_2 molecules disappear at 5000-6000° K, NO at 6000-7000° K, N_2 at 8000-9000°K, N and O atoms at 18,000-20,000° K. The N^+ and O^+ ions appear at 8000-9000° K.

Kon'kov, A. A. and A. V. Vorontsov. Experimental investigation of infrared radiation from nitrogen. OiS, v. 32, no. 4, 1972, 655-660.

Infrared radiation from the free-free transitions of electrons in fields of nitrogen atoms is discussed. The aim was to eliminate some contradictions in the data on the infrared radiation from nitrogen, and to expand the range of conditions for infrared radiation investigations.

Nitrogen absorption coefficients were measured in the temperature range of 7000-8500° K, at pressures of 30-75 atm, and wavelengths of 2-6 μ. The nitrogen was heated by a shock tube, and the nitrogen gas parameters were determined on the basis of the shock-wave velocity. It is shown that the absorption from the free-free transition of electrons in nitrogen atom fields can be described by the relationship obtained by Firsov and Chibisov (ZhETF, v. 39, 1960, 1770) if $\sigma'_N = 1.6 \times 10^{-15}$ cm^2, and $\sigma'_{N_2} = 2.7 \times 10^{-15}$ cm^2, where σ is the electron elastic scattering cross section.

Chernyshevich, I. V., and I. P. Zhuk. Three-dimensional problems of non-stationary thermal conductivity of solids under thermal destruction. IAN B, no. 2, 1972, 101-106.

A solution is presented to a boundary-value problem for heat conduction in solids with boundaries moving in accordance with an arbitrary law. The problem arises in surface breakdown by intense heat flux and gas ablation, and is related to the protection of structures and assemblies against such intense heat by coatings undergoing phase transformations. Model configurations were a solid and a hollow cylinder, and a finite parallelepiped. In each case, the problem is formulated by a partial differential equation for heat conduction with initial and boundary conditions assuming that a total geometric surface area burn off. In the simplest case, of a solid cylinder with only one moving boundary, the heat conduction equation is

$$a\left(\frac{\partial^2 t}{\partial r^2} + \frac{1}{r}\frac{\partial t}{\partial r} + \frac{1}{r^2}\frac{\partial^2 t}{\partial \varphi^2} + \frac{\partial^2 t}{\partial z^2} - bt\right) + f(r, z, \varphi, \tau) = \frac{\partial t}{\partial \tau}, \qquad (1)$$

and the initial and boundary conditions are

$$t[r, \mu(\tau), \tau, \varphi] = M(r, \varphi, \tau) \tag{2}$$

$$t[r, \eta(\tau), \tau, \varphi] = N(r, \varphi, \tau), \tag{3}$$

$$t[S(\tau), z, \tau, \varphi] = T_0(z, \varphi, \tau), \tag{4}$$

$$t(r, z, \varphi, 0) = f_0(r, z, \varphi). \tag{5}$$

For the hollow cylinder and the parallelepiped additional boundary conditions of the third kind are formulated, for the second and third boundary respectively. Equation (1) with conditions of (2) - (5) is solved by successively applying the Fourier cosine transform, Hankel transform, Green's function for the first boundary-value problem, and a contour integral. Application of the inversion formula to the finite integral transform yields the solution

$$t(r, z, \varphi, \tau) = \frac{1}{\pi S^2(\tau)}\left\{\sum_{k=1} \frac{t^*(\alpha_k, z, 0, \tau) J_0(\alpha_k r)}{J_1^2[\alpha_k S(\tau)] + J_0^2[\alpha_k S(\tau)]} + 2\sum_{n=1}^{\infty}\sum_{k=1}^{\infty} \frac{t^*(\alpha_k, z, n, \tau) J_n(\alpha_k r)\cos n\varphi}{J_n'^2[\alpha_k S(\tau)] + \left[1 - \frac{n^2}{\alpha_k^2 S^2(\tau)}\right] J_n^2[\alpha_k S(\tau)]}\right\}. \tag{6}$$

A similar procedure gives the final solutions of the problem for a hollow cylinder:

$$\begin{aligned} t(r, z, \varphi, \tau) = {} & \frac{1}{\pi}\sum_{k=1} t^*(\alpha_k, z, 0, \tau) V_0(\alpha_k r)\} (S_2^2(\tau)\{V_1^2[\alpha_k S_2(\tau)] + \\ & + V_0^2[\alpha_k S_2(\tau)]\} - S_1^2(\tau)\{V_1^2[\alpha_k S_1(\tau)] + V_0^2[\alpha_k S_1(\tau)]\})^{-1} + \\ & + \frac{2}{\pi}\sum_{k=1}^{\infty}\sum_{n=1}^{\infty} t^*(\alpha_k, z, n, \tau) V_n(\alpha_k r)\cos n\varphi \times \\ & \times \left\{S_2^2(\tau)\left[V_n'^2(\alpha_k S_2(\tau)) + \left(1 - \frac{n^2}{\alpha_k^2 S_2^2(\tau)}\right)V_n^2(\alpha_k S_2(\tau))\right] - \right. \\ & \left. - S_1^2(\tau)\left[V_n'^2(\alpha_k S_1(\tau)) + \left(1 - \frac{n^2}{\alpha_k^2 S_1^2(\tau)}\right)V_n^2(\alpha_k S_1(\tau))\right]\right\}^{-1}, \end{aligned} \tag{7}$$

and a finite parallelepiped:

$$t(x, y, z, \tau) = \frac{8}{S_1(\tau) S_2(\tau) S_3(\tau)} \times$$

$$\times \sum_{k=1}^{\infty} \sum_{m=1}^{\infty} \sum_{n=1}^{\infty} t(\mu_k, \eta_m, \gamma_n, \tau) W_1(\mu_k x) W_2(\eta_m y) W_3(\gamma_n z). \tag{8}$$

It is noted that to determine the temperature distribution for a hollow cylinder or a parallelepiped, it is necessary to: (a) find the roots α_k of a transcendental equation, such as

$$Y_n[\alpha S_1(\tau)] J_n[\alpha S_2(\tau)] = J_n[\alpha S_1(\tau)] Y_n[\alpha S_2(\tau)]. \tag{9}$$

for a hollow cylinder; (b) determine the kernel V_n of the integral transform, e.g.,

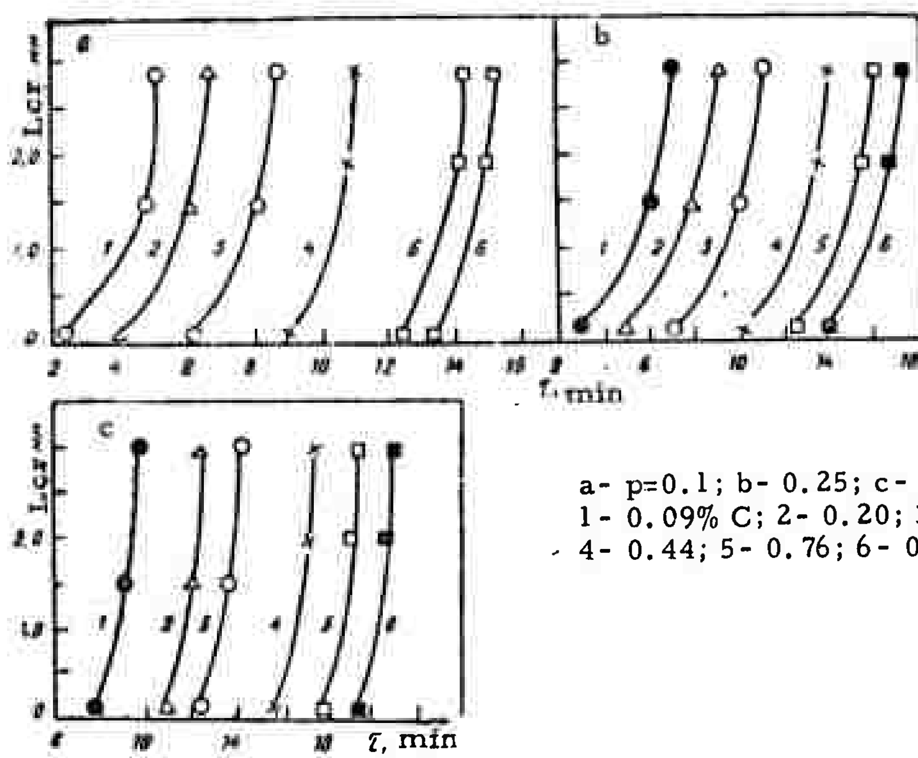
$$V_n(\alpha_k r) = Y_n[\alpha_k S_1(\tau)] J_n(\alpha_k r) - J_n[\alpha_k S_1(\tau)] Y_n(\alpha_k r), \tag{10}$$

and (c) apply the (7) or (8) formula. The laws of motion $S(\tau)$, $S_1(\tau)$, $S_2(\tau)$, and $S_3(\tau)$ of the boundaries in (4), and (6) to (10) are equicontinuous functions which do not vanish for any $\tau > 0$.

The solution is applicable to a variety of physical problems which can be described by parabolic equations with movable boundaries. Extension of the solution to more complex bodies (an ellipsoid, a paraboloid, and a hyperboloid) is planned.

Panasyuk, V. V., S. Ye. Kovchik, and N. S. Kogut. Method for formation of axisymmetric cracks in cylindrical forms. F-KhMM, no. 2, 1972, 95-97.

A method is described for initiating annular axisymmetric, rigidly concentric surface cracks in small and large diameter cylindrical specimens. Improving on impact-fatigue and cylindrical bending methods, this method involves minimal time expenditure and uses simple laboratory equipment; it also permits monitoring of the depth in load crack growth. Cylindrical specimens 6 mm in diameter, with annular v-shaped incisions were prepared from several types of carbon steel. These were subjected to cylindrical circular bending at a constant angular velocity (700 rpm) and a fixed deflection. Relationships between the crack length and the rotation time were constructed for each type of steel (Fig. 1).



a- p=0.1; b- 0.25; c- 0.5 mm;
1- 0.09% C; 2- 0.20; 3- 0.22;
4- 0.44; 5- 0.76; 6- 0.87% C

Fig. 1. Relationship of crack length ($L_{cr.}$) to the cyclical loading (τ) duration of carbon steel specimens with differing carbon content (f = 0.5 mm).

The relationship of the time required for the formation of a crack of given depth (1.5 mm) to the carbon content of the steels and the incision radius of the specimens was also constructed on the basis of the experimental data. Using these relationships, it is possible in each instance to obtain an initial annular crack with the required dimensions.

Gol'dman, A. Ya., V. V. Matveyev, and V. V. Shcherbak. <u>Crack propagation in polymers under creep conditions in air and liquid.</u> F-KhMM, no. 2, 1972, 28-33.

A study was made of the nature of breakdown and the kinetics of crack propagation in variable density polyethylene under creep conditions in air and liquid. Crack propagation in air was studied in a four-position facility, and the creep and durability in a surface-active medium were studied in a 10-position facility with photographic attachments. The crack propagation in this medium was a purely physical process, with no chemical changes in the polymer.

In the propagation of natural cracks in high-density polyethylene (HDPE), the brittle breakdown is partially accompanied by cold elongation or quasibrittleness, leading to the formation of a single main crack. The incubation period of crack formation may vary considerably, depending upon the load value. When it is optically visible, a wedge-shaped crack may become blunted as its length increases, and the propagation rate will sometimes be retarded by extended filaments.

In the elongation to a 12% degree of deformation of two fluorolon specimens (one slowly cooled, the other quenched), micro-crack concentration in the slowly-cooled specimen was higher than in the quenched one. This was due to the higher crystallinity in the annealed (70%) than in the quenched samples (50%). Creep curves of HDPE in air at 70^{o} show that as the stress increases the limit deformation prior to breakdown also increases, amounting to 8-10% at a stress of $\sigma = 55\ kg/cm^2$. The relationship of crack propagation rate to reduced time in air and in liquid is shown in Fig. 1. Crack propagation is spasmodic, particularly in liquid. The action of a surface-active medium is evidently reflected in an increase of the stress concentration at the terminus of the developing crack.

Fig. 1b shows the relationship of the increased rate of natural cracks to initial length under creep conditions. Although the stresses in the liquid tests were half as strong as those in air, the V_{cr} in an emulsion solution (curve 1) is much greater than in air (curve 2).

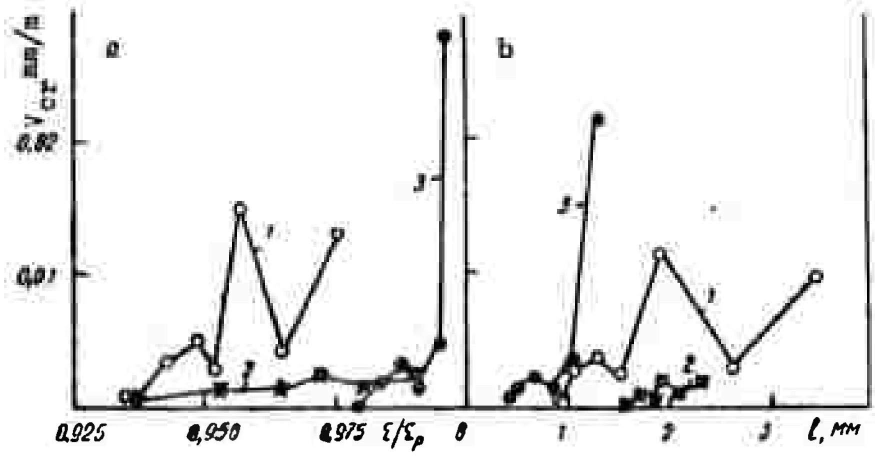


Fig. 1. Relationship of the propagation rate of a natural crack (V_{cr}) in HDPE under creep conditions at 70° C to: a- the reduced time τ/τ_p (where τ is the elapsed time since the induction period, τ_p is longevity); and b- the initial crack length (ℓ): 1 - in the emulsifier medium at $\sigma = 25\ kg/cm^2$; 2- in air, $50\ kg/cm^2$; and 3- in the emulsifier medium, $13\ kg/cm^2$).

Regel', V. P., A. M. Leskovskiy, and U. Bolibekov. Kinetics of crack growth in polymers under repeated loads with a small number of cycles. MP, no. 2, 1972, 247-251.

The kinetics of crack growth in experiments with repeated loading was investigated by tracing the development of incision-initiated cracks. The goal was to test the assumption that the longevity decrease in experiments with a small number of loading cycles is associated with the origination of an overstress peak and a heating effect at the maximum stress concentration points at the instant of each loading. The investigation was conducted using cinephotomicrography of transparent hydrated cellulose and polycaproamide films 30-70 μ thick under uniaxial elongation.

In the kinetics of crack growth from an incision during single loading under the conditions of a constantly acting load and at the instant of load application, the initial crack growth rate is high in comparison to the succeeding, much lower rate at the stage corresponding to the stabilized sector of the creep curve. The rate decrease is accompanied by a change in the configuration of the crack terminus from the relatively acute wedge of the incision to a more rounded and blunter shape. In tests at -196° C, a freshly incised crack was shown to cause more damage than a crack that had developed under load. The rupture load for specimens with an incision of 400 μ was consequently almost three times greater than for a specimen in which the crack from an initial incision of 50 μ had grown under a load at 20° to 400 μ.

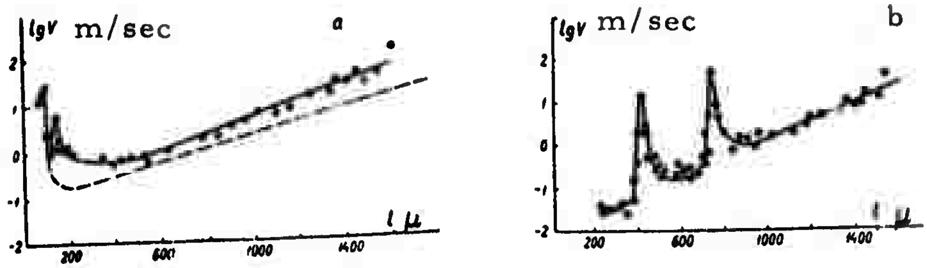


Fig. 1. Propagation rate vs. crack length

In Fig. 1a the relationship of the crack growth rate to the crack length in hydrated cellulose with repeated loadings (dotted line) in the first stage of crack development is plotted. The solid line represents continuous loading. Fig. 1b illustrates repeated loading in the second, stabilized stage of crack development. Successive loading and unloading apparently affects longevity less than repeated loadings in the first stage. Experiments were conducted at different testing temperatures and loading rates. Increasing the loading rate from 0.7 to 240 mm/sec caused the growth-rate surge amplitude to increase severalfold. Decreasing the testing temperature from 100° C to 22° C at a constant loading rate caused the surge amplitude to increase. At the instant of loading, local overstresses originate in the crack terminus due to the finite rate of relaxation processes. Local heating can also occur in the crack terminus.

Shermergor, T. D., and V. N. Dolinin.
Rheological characteristics of orthotropically-reinforced polymers. MP, no. 2, 1972, 276-283.

A model is developed for the rheological characteristics of orthotropically-reinforced polymers based on calculations of experimental values for elastic and rheological properties of individual components. This approach allows a drastic reduction in the number of parameters necessary for a complete specification of the anisotropy of elastic and rheolcgical properties of composite materials. The orthotropic material is assumed to consist of anisotropic grains randomly oriented along the x-y-z axes. Each grain has a laminar structure with alternating elastic and viscoelastic layers. The degree of anisotropy and the viscoelastic properties of the composite material can be varied to a large extent by a suitable choice of ten parameters (four elastic moduli, four concentration coefficients, and two rheological characteristics). Parameters of individual components are used to compute the rheological characteristics of the composite material either in the Foygt (sic) or Royce approximation. The authors point out that Foygt's method (based on the homogeneity of the microdeformation hypothesis) is useful for the determination of operators of elasticity and shear moduli, while the Royce approximation (the homogeneity of the microtension hypothesis) gives a simplified form of Young's modulus and Poisson's coefficients. Using the Royce approximation method, pliability matrices are derived for a viscoelastic composite in operator form and operator representations of 12 technical elastic moduli. Due to the orthotropic symmetry of the material, only 9 of these are independent. It is shown that each of the elastic moduli is represented by two real or complex resolvent Q* operators. The contributions of Young's moduli components are calculated for various concentrations and anisotropies, and conditions determined fcr discarding one of the Q* operators. For a complex exponential Q* operator with a

fractional exponent equal to -1/2, an integral kernel representation is derived, and time dependencies of the real and imaginary parts are computed and plotted. A graphical analysis shows that the representation of an elastic modulus by a complex Q* operator assures an energy decrease with tension relaxation in agreement with the second law of thermodynamics.

Karpinos, D. M., L. I. Tuchinskiy, M. L. Gorb, E. S. Umanskiy, and V. Ya. Fefer. Mechanical properties of titanium reinforced by unidirectional molybdenum wires. Problemy prochnosti, no. 6, 1972, 28-32.

The mechanical properties of type VT 1-0 titanium, reinforced with unidirectional wires of molybdenum M4, were investigated. Reinforcement wires 0.8 mm in diameter were wound unidirectionally on titanium matrix plates 0.08 mm thick. The wire volumetric content was regulated by the winding pitch, and comprised 10, 20, 32, and 44% by volume. Tensile strength and impact viscosity tests were conducted. Non-reinforced titanium plates were tested for comparison. The tensile strength was tested at 20, 400, 600, and 800° C; five specimens for each volumetric content of the reinforcement wire were tested at each temperature. At all investigated temperatures, a practically linear relationship was observed between the short-term tensile strength and the volumetric wire content V_w. An increase of titanium strength due to reinforcement is characterized by the strengthening coefficient K, which represents the ratio of the composition strength to the titanium strength at a specific temperature.

Fig. 1 shows the effect of temperature upon the value of K at different values of V_w. Fig. 2 shows the short-term tensile strength of reinforced titanium in relation to V_w. Comparison of the results with data on the known strength of the critical wire shows that 70-75% of the initial strand strength is utilized in the composition. In all the compositions studied, V_w is above the critical value.

Reinforcement by molybdenum wire sharply decreased the titanium plasticity and at normal temperature moderately increased its tensile strength. The modulus of normal elasticity E of molybdenum-wire reinforced titanium increased linearly with V_w according to the formula:

$$E = 204\ V_w + 10,000\ \text{kg/mm}^2$$

The specific modulus of elasticity (E/specific gravity) of the composition increased with V_w. Calculations reveal that when $V_w = 61\%$, the value at which the specific gravity of the Ti-Mo composition is equal to that of steel, $E = 22,500\ \text{kg/mm}^2$, which is about 10% greater than that of steel. Impact ductility tests (a, kg/cm^2) were made on specimens at various angles α between the specimen axis and the direction of the reinforcing s strands. The change of a is presented in relation to angle α (Fig. 3) and E_w (Fig. 4).

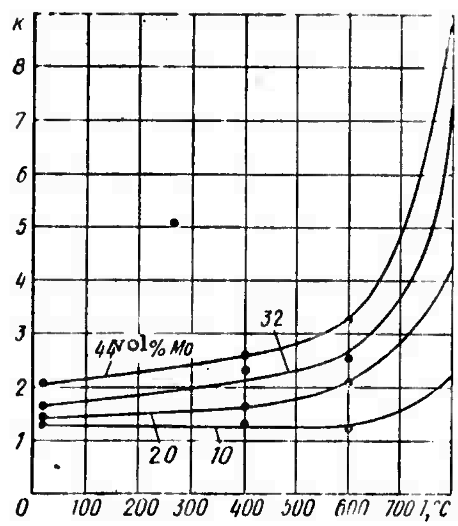


Fig. 1. Effect of temperature on strength coefficient, K.

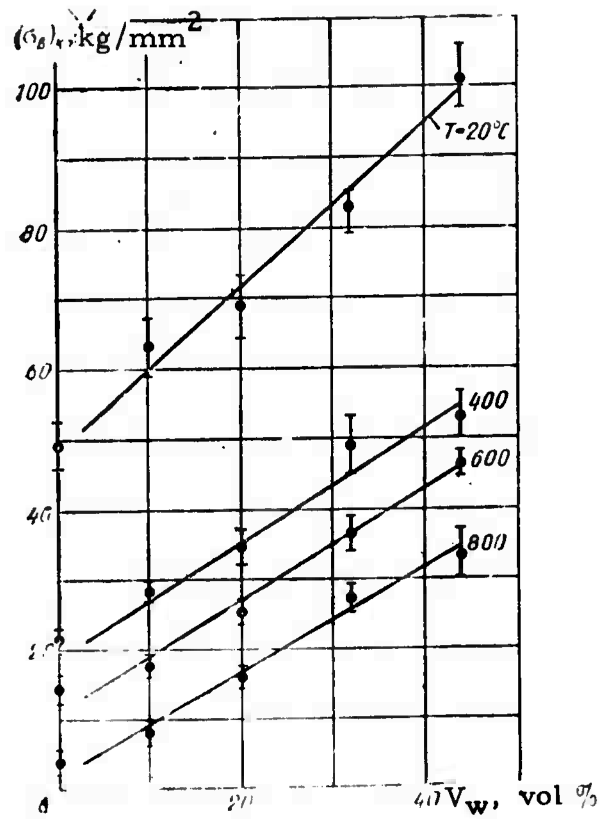


Fig. 2. Short term tensile strength of reinforced titanium.

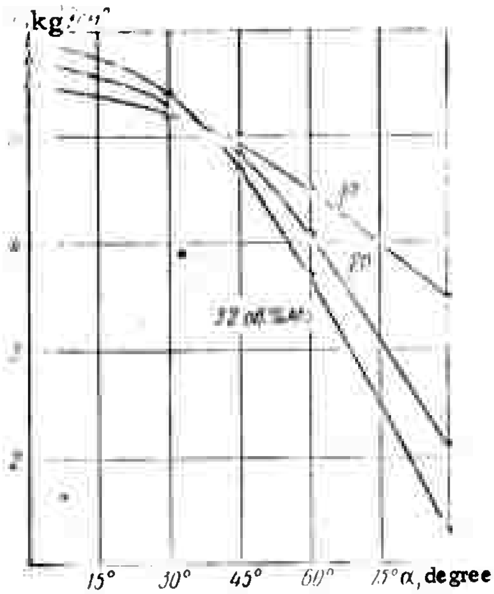


Fig. 3. Titanium impact viscosity as a function of angle, α.

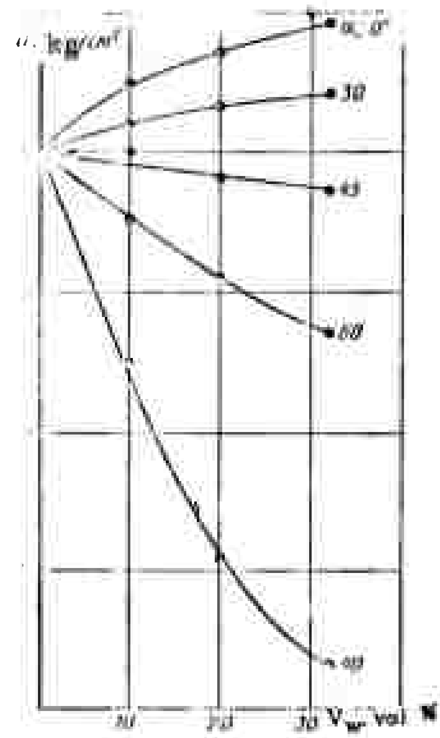


Fig. 4. Titanium impact viscosity as a function of molybdenum volumetric wire content, E_v.

B. Recent Selections

i. Crack Propagation

Andreykiv, A. Ye, and M. M. Stadnik. Buckling of a rectangular brittle beam weakened by an internal circular crack. F-KhMM, no. 4, 1972, 77-79.

Artykova, S. I., and K. N. Rusinko. Analysis of crack development in buckling of a brittle beam. MTT, no. 4, 1972, 173-176.

Kirilyuk, L. V., and M. Sh. Gol'dberg. Investigation of causes for development of dislocation cracks in ionic crystals. IN: Sbornik. Dielektriki, no. 1, 1971, 21-24. (RZhKh 19ABV, 14/72, no. 14B593)

Korsukov, V. Ye. V. I. Vettegren', I. I. Novak, and A. Chmel'. Molecular destruction of polymers at a mainline crack terminus. MP, no. 4, 1972, 621-625.

Mirsalimov, V. M. Method for arresting crack growth. IAN Az, Ser. fiz-tekh. i mat. nauk, no. 1, 1972, 34-38.

Mirsalimov. Limit of crack propagation rate from quasi-brittle failure. IAN Az, Ser. fiz-tekh. i mat. nauk, no. 1, 1972, 14-16.

Neustroyev, E. A. Determining the frequency of natural oscillations of reinforced concrete beams, taking crack formation into account. IN: Stroitel'naya mekhanika i raschet sooruzheniy, no. 2, 1972, 18-21. (RZhMekh, 7/72, no. 7V803)

Romaniv, A. N., Yu. V. Zima, V. I. Tkachev, and R. I. Kripyakevich. Investigation of the kinetics of low cycle fatigue of steels in a hydrogen atmosphere and in vacuum. F-KhMM, no. 3, 1972, 75-80.

Romaniv, O. N., Yu. D. Petrina, and Yu. V. Zima. Characteristics of crack propagation under cyclic loads in liquid media. F-KhMM, no. 4, 1972, 35-38.

Savruk, M. P. Antisymmetric load stress in a plate with an infinite series of parallel cracks. F-KhMM, no. 4, 1972, 109-111.

Sklyuyev, P. V. Determining characteristics of crack initiation and growth using results of impact strength tests of nitrated specimens. ZL, no. 7, 1972, 874-875.

Yarema, S. Ya., M. P. Savruk, and Ya. K. Nechayev. Temperature distribution in thermally insulated cracks in plates under various boundary conditions. I-FZh, v. 23, no. 3, 1972, 528-532.

ii. High Pressure Research

Boganov, A. G., S. A. Popov, and L. P. Makarov. Laboratory device for high pressure and high temperature investigations. PTE, no. 4, 1972, 205-208.

Boguslavskiy, Yu. Ya., F. F. Voronov, and S. B. Grigor'yev. Calculation of dynamic modulus of solids under pressure. ZhPMTF, no. 4, 1972, 162-170.

Broyde, Ye. L. Pressure dependence of electric and thermoelectric properties of antimony. ZhETF, v. 63, no. 2, 1972, 579-582.

Grigor'yev, F. V., S. B. Kormer, O. L. Mikhaylova, A. P. Tolochko, and V. D. Urlin. Experimental determination of hydrogen compressibility at densitites of 0.5-2g/cm^3. ZhETF P, v. 16, no. 5, 1972, 286-290.

Kompaneyets, A. S., V. I. Romanova, and P. A. Yampol'skiy. Converting shock compression to isentropic. ZhETF P, v. 16, no. 4, 1972, 259-262.

Kotov, N. V., and N. N. Kopeykin. Equipment and methods for high temperature and high pressure investigations. Device for hydrothermal investigations at P_{H_2O} = 2000 kg/cm^2 and T to 850°C. VLU, no. 12, 1972, 139-143.

Mikhaylovskiy, I. M., and Zh. I. Dranova. Ion microscopic analysis of interstitial plasticity of tungsten single crystals. ZhETF, v. 63, no. 2, 1972, 567-572.

Mustafayev, R. A. Experimental investigation of thermal conductivity of n-tridecane at temperatures of 30-400°C and pressures to 500 bar. TVT, no. 4, 1972, 906-908.

Nikolayev, I. N., V. P. Mar'in, V. N. Panyushkin, and L. S. Pavlyukov. Alpha to beta Sn phase transition under pressure. FTT, no. 8, 1972, 2337-2339.

Verzhinskaya, A. B., Yu. D. Il'yukhin, and V. B. Nesterenko. Experimental stand for investigating isobaric heat capacity of dissociative nitrogen tetroxide at 140-660°C and 25-350 kg/cm^2. IAN B, Ser. fiz-energ. nauk, no. 3, 1972, 84 88.

Zubov, Yu. A., V. I. Selikhova, M. B. Konstantinopol'skaya, F. F. Sukhov, N. A. Slovokhotova, N. F. Bakeyev, A. V. Kryukov, V. A. Sokol'skiy, and G. P. Belov. High pressure annealing effect on oriented polyethylene. Vysokomolekulyarnyye soyedineniya, no. 9, 1972, 2090-2096.

iii. High Temperature Research

Alova, G. Burning without burning out. (Self-propagating high temperature synthesis of compounds). Science and Engineering. APN newsletter, Novosti Press Agency, 33/72, 1-2.

Andreyeva, L. P. Electrical conductivity and migration polarization of magnesium oxide at high temperatures. IVUZ Fiz, no. 8, 1972, 148-149.

Belyayev, G. S. Heating effect on strength and structure of a reinforced layer. IN: Trudy TsNII tekhnologii sudostroyeniya, no. 120, 1972, 14-17. (LZhS, 36/72, no. 120329)

Borovoy, V. Ya., and M. V. Ryzhkova. Heat transfer on a half-cone leeward convex surface. IN: Trudy Tsentral'nogo aerogidrodinamicheskogo instituta, no. 1315, 1971, 109-120. (LZhS, 32/72, no. 106017)

Borovoy, V. Ya., and V. N. Kharchenko. Experimental investigation of heat transfer from an axisymmetric body with a conical flap. IN: Trudy Tsentral'nogo aerogidrodinamicheskogo instituta, no. 1315, 1971, 121-130. (LZhS, 32/72, no. 106018)

Bykov, V. N., S. T. Voronkov, V. L. Dekhtyarev, L. P. Tomasheva, V. G. Pogontsev, and Ye. N. Tereshchenko. Experimental investigation of the effective thermal conductivity of fiber insulation in compressed gases. TVT, no. 4, 1972, 788-795.

Chauser, M. G., O. G. Sel'skaya, T. N. Zhuykova, M. I. Cherkashin, and A. A. Berlin. Structural transformations of diphenylbutadiene from thermal oxidation. Vysokomolekulyarnyye soyedineniya, no. 9, 1972, 1949-1955.

Gitis, M. B., and A. G. Kopanskiy. High temperature measurement of coefficient of ultrasonic absorption in solids. Akusticheskiy zhurnal, no. 3, 1972, 381-385.

Glebov, L. A., V. A. Lavrenko, and V. M. Timoshenko. Device for studying high temperature kinetics of materials behavior in atomic and molecular gases and in a vacuum. ZhFKh, no. 8, 1972, 2133-2135.

Khaybullin, I. Kh., and B. Ye. Novikov. Gamma radioscopy measurement of high temperature parameters of saturated solutions. TVT, no. 4, 1972, 895-897.

Kirillov, V. S., V. I. Safonov, and V. V. Tychina. Monochromatic emissivity of a TiC-ZrC system. TVT, no. 4, 1972, 902-905.

Kleyner, M. K. Approximate solution to a problem on heating of large bodies under variable water-equivalent of gas. I-FZh, v. 23, no. 3, 1972, 506-513.

Kornilov, A. A., and A. G. Trapezon. High frequency device for investigating fatigue of sheet materials under conditions of a planar stress state and high temperature. ZL, no. 7, 1972, 876-878.

Lebedev, D. P., and V. V. Samsonov. Characteristics of internal heat and mass transfer in a vacuum during sublimation. I-FZh, v. 23, no. 3, 1972, 424-429.

Lozhkin, V. L., and Yu. A. Ryzhov. Roughness effect in the interaction of a rarefied gas with a solid surface. ZhPMTF, no. 4, 1972, 68-75.

Lyubchenko, N. P., and B. A. Zhubanov. Synthesis and analysis of polyimidobenzimidazoles. IAN Kaz, Seriya khim, no. 4, 1972, 49-53.

Petrov, V. A., and V. Yu. Reznik. Integral normal emissivity of KI-type quartz glass at high temperatures. TVT, no. 4, 1972, 778-782.

Sepp, V. A. Effect of transverse magnetic field on high temperature electrical conductivity gas flow in a channel with high thermal insulation. ZhPMTF, no. 4, 1972, 177-179.

Sultanov, M. A. Effect of degree of oriented stretching on destruction mechanism in polymer films under supersonic plasma flow. Vysokomolekulyarnyye soyedineniya, Kratkiye soobshcheniya, no. 2, 1972, 94-96.

Vargin, A. N., L. M. Pasynkova, and Ye. S. Trekhov. Emissivity of CO_2 plasma at temperatures of 7000-9000°K and a spectrum interval of 2100-1000 Å. TVT, no. 4, 1972, 732-738.

Yelyutin, V. P., Yu. A. Pavlov, and V. S. Chelnokov. Aluminum oxide interaction with carbon at 2000-2400°K. IVUZ Tsvetnaya metallurgiya, no. 4, 1972, 43-46.

Zhigulev, V. N. Gas motion around highly heated bodies. ZhPMTF, no. 4, 1972, 95-98.

iv. Miscellaneous Strength of Materials

Berlin, A. A., G. V. Belova, and A. I. Sherle. Thermal stability of azaporphin. Vysokomolekulyarnyye soyedineniya, no. 9, 1972, 1970-1975.

Bolotin, Yu. I., V. A. Greshnikov, Yu. B. Drobot, V. M. Kochev, and L. N. Nikolayev. Problems in measuring strength characteristics of metals. IN: Trudy Sibirskiy NII metrologii, no. 13, 1971, 92-106. (RZhMekh, 7/72, no. 7V910)

Budnevich, S. S., and S. Uskenbayev. Experimental results on heat transfer to liquefied gases in the supercritical state. IVUZ Energ, no. 8, 1972, 63-67.

Bulavs, F. Ya., Ya. V. Auzukalns, and A. M. Skudra. Deformation characteristics of plastics reinforced with high modulus anisotropic fibers. MP, no. 4, 1972, 631-639.

Dvorina, L. A., Ye. V. Yukhimenko, and S. A. Vdovenko. High temperature interactions of titanium diboride with titanium disilicide and silicon. Poroshkovaya metallurgiya, no. 4, 1972, 61-65.

(Elastosil: general purpose coating for semiconductor devices). Kazakhstanskaya pravda, 8/12/72, p. 1.

Fetisova, M. M., G. D. Pogrebnyak, and E. I. Pleshakov. Characteristics of carbon steel destruction under development of temper brittleness. F-KhMM, no. 4, 1972, 89-90.

Fugol', I. Ya., Ye. V. Savchenko, and A. G. Belov. Luminescence of solid neon. ZhETF P, v. 16, no. 4, 1972, 245-249.

Gartseva, L. Ye., L. V. Levchuk, V. N. Mordkovich, and M. I. Starchik. Behavior of oxygen-containing silicon under simultaneous heat treatment and irradiation. IN: Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 1, 1971, 284-288. (LZhS, 30/72, no. 98417)

Gur'yanova, V. V., I. O. Yelin, C. A. Tarakhtunov, A. I. Chechik, V. P. Pshenitsyna, L. Ye. Kashtanova, M. S. Akutin, and B. M. Kovarskaya. Heat treatment processes in 3,3'-dimethoxy-substituted aromatic polyamide. Vysokomolekulyarnyye soyedineniya, no. 9, 1972, 1964-1969.

Ivanov, A. P. Kinetics of heating an optical scattering layer by beamed heat exchange. ZhPS, v. 17, no. 3, 1972, 507-512.

Kaminskiy, A. A. Destruction of brittle bodies with random rough surfaces. PM, no. 8, 1972, 82-89.

Kareta, N. L., and V. N. Sladkova. Fracture effective surface energy and brittle failure in steel. F-KhMM, no. 4, 1972, 74-77.

Kasatochkin, V. I., Z. S. Smutkina, M. Ye. Kazakov, N. P. Radimov, A. P. Nabatnikov, and T. D. Yares'ko. Molecular structure of anisotropic carbon fiber. DAN SSSR, v. 205, no. 5, 1972, 1090-1092.

Kayuk, Ya. F., and V. I. Pavlenko. Thermal stability of an oblique plate. IN: Sbornik. Voprosy dinamiki i prochnosti. Riga, Izd-vo Zinatne, no. 22, 1972, 159-168. (RZhMekh, 7/72, no. 7V249)

Khardin, A. P., and V. Ye. Derbisher. Single-stage synthesis of skeleton poly-1,3,4 oxadiazoles. Vysokomolekulyarnyye soyedineniya, Kratkiye soobshcheniya, no. 8, 1972, 565.

Kilikovskaya, O. A. Effect of contact pressure-dependent thermal resistance on stress in conjugate bodies. MTT, no. 4, 1972, 202.

Konopleva, R. F., et al. Osobennosti radiatsionnogo povrezhdeniya poluprovodnikov chastitsami vysokikh energiy. (Radiation damage to semiconductors by high energy particles). Moskva, Izd-vo Atomizdat, 1971, 76p.

Korshak, V. V., A. V. Vinogradov, Z. T. Al'-Khaydar, G. M. Tseytlin, and V. V. Rode. Properties of hydroxyl-content polypyromellitic imides. Vysokomolekulyarnyye soyedineniya, Kratkiye soobshcheniya, no. 8, 1972, 592-595.

Korshak, V. V., S. V. Vinogradova, Ya. S. Vygodskiy, Z. V. Gerashchenko, and N. I. Lushkina. Hydrolytic stability of certain polyimides. Vysokomolekulyarnyye soyedineniya, no. 9, 1972, 1924-1928.

Kramarov, M. A., and Yu. V. Shakhnazarov. Brittle failure resistance of high temper steels with martensite and bainitic initial structure. MiTOM, no. 9, 1972, 78-79.

Kushnir, I. P., and Ye. F. Sidokhin. X-ray analysis of iron microcrystal substructure. FTT, no. 8, 1972, 2458-2460.

Kuznetsov, N. P., M. I. Bessonov, T. M. Kiseleva, and M. M. Koton. Synthesis and analysis of properties of aromatic polybenzimidazole imides. Vysokomolekulyarnyye soyedineniya, no. 9, 1972, 2034-2041.

Layner, D. I., M. I. Tsypin, A. V. Novikov, and N. V. Cherkashina. Strength, plasticity, and superplasticity of copper ingots. Tsvetnyye metally, no. 8, 1972, 70-71.

Matusevich, I. S. Production of complex shaped cermet parts. Poroshkovaya metallurgiya, no. 4, 1972, 49-52.

Mikhaylovskiy, E. M., K. K. Pakhotin, and L. M. Sedokov. Coefficient of lateral deformation during strain and failure. IN: Izvestiya Tomskogo politekhnicheskogo instituta, no. 225, 1972, 15-18. (RZhMekh, 7/72, no. 7V929)

Minkin, Ye. V., M. P. Letunovskiy, S. I. Semenets, and Yu. V. Zelenev. Deformation properties of several glassy polymers. MP, no. 4, 1972, 717-720.

Negmatov, S. S., S. Gulyamiddinov, Kh. T. Tadzhikhanov, and I. Nasirov. Strength of powdered polyethylene coatings. IN: Trudy TashPI, no. 64, 1970, 187-190. (LZhS, 36/72, no. 120336)

Novikov, I. I., V. K. Portnoy, Yu. P. Kosikhin, N. A. Sinitsina, and G. S. Plekhanova. Effect of composition and structure on mechanical properties of Al-Zn superplastic alloys. IVUZ Tsvetnaya metallurgiya, no. 4, 1972, 128-132.

Okhrimenko, Ya. M., O. M. Smirnov, L. V. Surmach, and M. M. Kuchinov. Superplasticity of VTZ-1 titanium alloy. IVUZ Tsvetnaya metallurgiya, no. 4, 1972, 133-136.

Pustovalov, V. V., and V. P. Silin. Stationary turbulence of a parametrically non-stable plasma. ZhETF P, v. 16, no. 5, 1972, 308-311.

Serdobol'skaya, O. Yu., and Kuak Tkhi Tam. Nonlinear effects of sound propagation near a phase transition in a ferroelectric. FTT, no. 8, 1972, 2443-2445.

Shul'te, Yu. A., E. I. Tsivirko, I. A. Garevskikh, V. I. Gontarenko, and S. I. Adamchuk. Mechanical properties of bearing steels at high temperatures. MiTOM, no. 9, 1972, 72-73.

Sirota, N. N., V. I. Gostishchev, and A. A. Drozd. Low temperature thermal conductivity of aluminum in strong magnetic fields. ZhETF P, v. 16, no. 4, 1972, 242-245.

Stepnov, M. N., and M. A. Trushkin. Secondary fatigue curve analysis of aluminum alloy fatigue properties under variable loads. ZL, no. 7, 1972, 860-

Tikhonov, A. S., and M. Kh. Shorshorov. Diffusion in superplastic aggregates. DAN SSSR, v. 205, no. 5, 1972, 1079-1082.

Tsipenyuk, I. F., V. A. Rzhevskiy, and G. A. Senterev. Analysis of reliability of standard calculations of seismic interactions in reinforced concrete structures. Stroitel'stvo i arkhitektura Uzbekistana, no. 12, 1971, 9-12. (RZhMekh, 7/72, no. 7V798)

Tyavlovskiy, M. D. Ultrasonic cyclic loading fatigue of duralumin. IAN B, Seriya Fiz-tekh. navuk, no. 3, 1972, 29-38.

Varvak, A. P., M. Shch. Varvak, and A. S. Dekhtyar'. Destruction of tapered shells with random parameters. IN: Sbornik. Raschet prostranstvennykh stroitel'nykh konstruktsiy. Kuybyshev, no. 2, 1971, 105-109. (RZhMekh, 7/72, no. 7V384)

Vinetskiy, V. L., and I. I. Yaskovets. Determining effective injection rate of radiation defects. IN: Radiatsionnaya fizika nemetallicheskikh kristallov, v. 3, part 1, 1971, 142-146. (LZhS, 30/72, no. 98279)

Vladimirov, V. I. Stress dependence of the activation energy process of destruction. FTT, no. 8, 1972, 2274-2281.

Zaytsev, N. I., and V. I. Korobko. Actual failure configuration of polygonal plates with unidirectional thickness variation. IN: Trudy Sibirskiy NII metrologii, no. 13, 1971, 79-83. (RZhMekh, 7/72, no. 7V388)

Zhadan, T. A., and A. A. Babakov. Intercrystal failure of stainless high-silicon steels. MiTOM, no. 7, 1972, 63-64.

v. Superconductivity

Abramov, Yu. Yu., L. A. Bol'shov, and V. A. Roslyakov. Filament model of a porous material superconductor. FTT, no. 8, 1972, 2225-2230.

Afonchenkov, N. G. Cryostat for a horizontal superconducting solenoid with a heated working volume. PTE, no. 4, 1972, 256.

Anan'yev, L. L., and N. P. Gerasimov. Tuning device for superconducting oscillating systems. Otkr izobr, no. 26, 1972, no. 350137.

Baranov, I. A., A. A. Tovma, and Yu. G. Chervyakov. Superconducting magnetic systems in shf electronics. IN: Sbornik. Elektronnaya tekhnika. Kriogenicheskaya elektronika, no. 1(3), 1971, 84-94. (RZhRadiot, 9/72, no. 9D540)

Bashkirov, Yu. A. Superconductivity: achievements and future prospects. Khimiya i zhizn', no. 9, 1972, 45-48.

Bertinov, A. I., O. M. Mironov, and V. S. Mokin. Inductance of a cryogenic synchronous machine with a damping system. IAN Energ, no. 4, 1972, 56-60.

Bertinov, A. I., and O. M. Mironov. Selection of basic dimensions of a synchronous generator with a superconducting inductor. IAN Energ, no. 4, 1972, 29-38.

Blinkov, Ye. L., and Ye. S. Gol'denberg. Optimization of conditions for circulation of cooling agents in cryogenic cables. IAN Energ, no. 4, 1972, 101-107.

Bogachkov, M. L., and S. R. Glinternik. Relationship of transient processes and control conditions to parameters of an a-c superconducting cable transmission line. IAN Energ, no. 4, 1972, 14-20.

Borzov, G. G., I. A. Glebov, L. P. Gnedin, V. V. Dombrovskiy, V. G. Novitskiy, and V. N. Shakhtarin. Problems in building a high power turbogenerator with superconducting field windings. IAN Energ, no. 4, 1972, 21-28.

Borzov, G. G., and N. I. Solnyshkin. Calculation of the magnetic field in a saddle-shaped superconducting coil with a ferromagnetic shield. IAN Energ, no. 4, 1972, 77-80.

Botoshan, N. I., V. A. Moskalenko, and A. M. Ursu. Density of electron states in dual-zone superconductors with a non-magnetic impurity. TMF, v. 12, no. 2, 1972, 264-282.

Butorin, V. M., V. M. Dmitriyev, Ye. F. Krivosheyev, V. A. Pavlyuk, and O. A. Tret'yakov. Matching of a film superconducting tunnel contact system with a free space. RiE, no. 9, 1972, 1885-1892.

Demirchyan, K. S., and N. T. Solnyshkin. Finite-difference method study of cryolectric machine magnetic fields in nonrestricted regions. IAN Energ, no. 4, 1972, 97-100.

Formozov, B. N., and M. A. Kolchin. Remodelling of the UVN-2U device for preparation of superconducting film circuits. IN: Sbornik. Elektronnaya tekhnika. Kriogenicheskaya elektronika, no. 13, 1971, 160-162. (RZhRadiot, 9/72, no. 9D542)

Galayko, V. P., and Ye. V. Bezuglyy. Thermal conductivity of the intermediate state in superconductors. ZhETF, v. 63, no. 2, 1972, 713-728.

Kazovskiy, Ye. Ya., and Yu. F. Antonov. Theory of a superconducting magnetic flux pump with a plate. IAN Energ, no. 4, 1972, 66-76.

Klabik, V., M. Litomisky, J. Ruzicka, and M. Sittner. Processing of a superconducting alloy (Zr-0-Nb). Patent ChSSR, no. 140283, published 2/15/71. (RZhRadiot, 9/72, no. 9D553 P)

Kocharyan, A. N., and D. I. Khomskiy. Effect of an unfilled narrow zone on the superconductivity of transition and rare earth metals. FTT, no. 8, 1972, 2421-2424.

Komnik, Yu. F. Superconductivity of thin films. I. Critical temperature. IN: Trudy. Fiz.-tekhn. institut nizkikh temperatur AN UkrSSR, no. 16, 1971, 3-28. (RZhRadiot, 8/72, no. 8D467)

Komnik, Yu. F. Superconductivity of thin films. II. Critical magnetic fields. IN: Trudy Fiz-tekhn. institut nizkikh temperatur AN UkrSSR, no. 16, 1971, 29-41. (RZhRadiot, 8/72, no. 8D468)

Lazarev, B. G., O. N. Ovcharenko, and I. S. Martynov. Direct observation of magnetic microstructure in deformed niobium superconducting alloys. DAN SSSR, v. 205, no. 6, 1972, 1343-1345.

Kresin, V. Z. Problem of superconducting mechanisms. IN: Uchenyye zapiski Moskovskogo zaochnogo PI, no. 30, 1971, 108-110. (LZhS, 37/72, no. 122243)

Kresin, V. Z., and V. A. Litovchenko. Electrodynamics of superconductors. IN: Uchenyye zapiski Moskovskogo zaochnogo PI, no. 30, 1971, 111-116. (LZhS, 37/72, no. 122244)

Kresin, V. Z., and Tavger, B. A. Potential mechanism of superconductivity in semiconductors and metal films. IN: Uchenyye zapiski Moskovskogo zaochnogo PI, no. 30, 1971, 117-123. (LZhS, 37/72, no. 122245)

Leskov, B. A., and V. I. Matorin. Effect of heat treatment on mechanical properties of type 65BT superconducting alloy. IN: Sbornik trudov TsNIIChM, no. 78, 1971, 242-250. (LZhS, 35/72, no. 117047)

Likharev, K. K., and V. K. Semenov. Properties of a superconducting point contact installed in a resonator. RiE, no. 9, 1972, 1983-1986.

Medvedev, Yu. V. Theory of anomalous superconductors. IN: Uchenyye zapiski Moskovskogo zaochnogo PI, no. 30, 1971, 189-191. (LZhS, 37/72, no. 122266)

Mikhnevich, G. V., Ye. L. Blinkov, and Ye. S. Gol'denberg. Application of superconductivity effect in energy transmission equipment. IAN Energ, no. 4, 1972, 6-13.

Mkrtchyan, G. S., F. R. Shakirzyanova, Ye. A. Shapoval, and V. V. Shmidt. Vortex interaction with boundary limits of two superconductors. ZhETF, v. 63, no. 2, 1972, 667-669.

Neyman, L. R. Promising prospects of using superconductivity to solve electrical energy supply problems. IAN Energ, no. 4, 1972, 3-5.

Novitskiy, V. G., and V. N. Shakhtarin. Electrodynamic force and mechanical stresses in superconducting magnetic systems. IAN Energ, no. 4, 1972, 50-55.

Perova, L. V., B. V. Tkachuk, B. N. Formozov. Application of electron-ion technology in preparation of superconducting thin film circuits. IN: Sbornik. Elektronnaya tekhnika. Kriogenicheskaya elektronika, no. 13, 1971, 172-173. (RZhRadiot, 9/72, no. 9D541)

Smirnov, A. P., and V. N. Totubalin. Low frequency absorption in mixed state of type II semiconductors. FTT, no. 8, 1972, 2479-2481.

Smirnov, A. P., and V. N. Totubalin. Stability limit of the superconducting state in type I superconductors. FTT, no. 8, 1972, 2390-2392.

Sychev, V. V. Problems in constructing superconducting magnetic systems. IAN Energ, no. 4, 1972, 39-49.

Sychev, V. V., V. B. Zenkevich, V. A. Al'tov, and N. A. Kulysov. "Double" solenoid method for investigating dynamic processes in a superconducting winding. IAN Energ, no. 4, 1972, 81-87.

Sychev, V. V., V. B. Zenkevich, V. A. Al'tov, and N. A. Kulysov. Method of regulating a low-ohm shunt for investigating volt-ampere characteristic of a combined superconductor. IAN Energ, no. 4, 1972, 88-96.

Tret'yakov, B. N., and V. B. Kuritsin. Investigation of superconducting properties and nmr parameters of V-Ga alloys. IN: Sbornik trudov TsNIIChM, no. 78, 1971, 128-133. (LZhS, 35/72, no. 115660)

Vedeneyev, S. I., A. I. Golovashkin, and G. P. Motulevich. Tunneling characteristics of Pb, Sn and Nb superconducting films obtained using low resistance contacts. KSpF, no. 4, 1972, 15-20. (RZhRadiot, 9/72, no. 9D530)

vi. Epitaxial Films

Anatychuk, L. I., V. T. Dimitrashchuk, and O. Ya. Luste. Method of measuring thermoelectromotive force in epitaxial layers. ZL, no. 7, 1972, 814-816.

Batavin, V. V., V. V. Rusakov, N. M. Zudkov, V. I. Prilipko, and M. A. Shevel'kov. Measurement of leakage current through an insulated p-n-junction in epitaxial structures. ZL, no. 7, 1972, 822-823.

Blinnikova-Vyazemskaya, Ye. V., and Yu. A. Kontsevoy. Method of investigating electrophysical parameters of silicon epitaxy. ZL, no. 7, 1972, 821-822.

Buyko, L. D., E. P. Kaloshkin, V. M. Koleshko, and G. G. Chigir'. Measuring device for alloy profile of epitaxial films. PTE, no. 4, 1972, 220-222.

Chetyrkina, N. A., Z. V. Karachentseva, V. V. Mitrofanov, T. T. Dedegkayev, N. A. Belov, R. N. Erlikh, and Z. V. Vasyutina. Effect of growth conditions on development of carbon occlusions in silicon epitaxy. IN: Sbornik. Elektronnaya tekhnika. Poluprovodnikovyye pribory, no. 1(58), 1971, 47-50. (RZhElektr, 9/72, no. 9B79)

Chistyakov, Yu. D., A. N. Paliyenko, D. N. Gulidov, and D. A. Sechenov. Growth properties of silicon autoepitaxy during application of an external electric field. IN: Sbornik nauchnykh trudov po problemam mikroelektron. Moskovskiy institut elektronnoy tekhniki, no. 8, 1972, 161-164. (RZhElektr, 9/72, no. 9B77)

Kuznetsov, Yu. N., V. V. Batavin, Yu. A. Bychkov, I. P. Korovin, V. S. Pantuyev, and V. I. Prilipko. Trends in development of methods and equipment for industrial quality control of silicon epitaxial structures. IN: Sbornik. Elektronnaya promyshlennost', no. 1, 1972, 12-17. (RZhElektr, 9/72, no. 9B45

Meyler, B. L., and I. F. Tigane. Initial development stages of zinc selenide epitaxial films. IN: Uchenyye zapiski Tartuskogo universiteta, no. 292, 1972, 91-101. (RZhKh ABV, 16/72, no. 16B609)

Mokiyevskiy, V. A., and R. N. Erlikh. Mechanism of packing defect formation in silicon autoepitaxial layers. IN: Sbornik. Elektronnaya tekhnika. Poluprovodnikovyye pribory, no. 1(58), 1971, 58-61. (RZhElektr, 9/72, no. 9B80)

Slotin, V. V., A. I. Buturlin, G. V. Duvanov, and Yu. D. Chistyakov. Feasibility of vapor-gas mixture composition control in the chloride process of preparing silicon autoepitaxial layers by a sorption layer piezoquartz micro-suspension method. IN: Sbornik nauchnykh trudov po problemam mikroelektron. Moskovskiy institut elektronnoy tekhniki, no. 8, 1972, 184-192. (RZhElektr, 9/72, no. 9B78)

Slotin, V. V., A. I. Buturlin, G. V. Duvanov, and Yu. D. Chistyakov. Thermodynamic analysis of hydrolysis reaction of $SiCl_4$ vapors. IN: Sbornik nauchnykh trudov po problemam mikroelektron. Moskovskiy institut elektronnoy tekhniki, no. 8, 1972, 193-199. (RZhElektr, 9/72, no. 9B81)

Tigane, I. F., and E. E. Tyurkson. Electron microscope analysis of early stages of ZnS epitaxial layer formation. IN: Uchenyye zapiski Tartuskogo universiteta, no. 292, 1972, 102-112. (RZhKh ABV, 16/72, no. 16B610)

Wlodarski, W., and M. Zegarski. Effect of hydrostatic pressure on statistical characteristics of planar and epitaxy-planar silicon diodes. Arch. elektrotechn, v. 21, no. 1, 1972, 229-231. (RZhElektr, 9/72, no. 9B169)

vii. Magnetic Bubble Materials

Borodin, V. A., A. M. Kadomtseva, N. M. Kovtun, and V. A. Khokhlov. Magnetostriction of holmium and dysprosium polycrystal orthoferrites. FTT, no. 8, 1972, 2253-2255.

viii. Surface Waves

Kaliski, S., and L. Solarz. Exact solution to a problem on an elastic surface wave waveguide. Biul. WAT J. Dabrowskiego, v. 21, no. 3, 1972, 19-32. (RZhRadiot, 8/72, no. 8B162)

Novichkov, Yu. N. Surface waves in a laminar elastic medium. IN: Trudy Moskovskogo energeticheskogo instituta, no. 101, 1972, 129-136. (RZhMekh, 7/72, no. 7V113)

Soluch, W., R. Lec, and A. Latuszek. Properties of elastic surface waves in $LiIO_3$. Bulletin De L'academie Polonaise Des Sciences, v. 22, no. 6, 1972, 139(473)-142(476).

6. Miscellaneous Interest

A. Abstracts

Bunin, V. A. A system of transmitting and receiving signals by means of gravity waves. Author's Certificate no. 347937. Otkr izobr, 24/72, 195. (Translation)

A system for transmitting and receiving signals via gravity waves is proposed, in which the transmitter is a body excited by a signal source using modulated mechanical or acoustical oscillations. The receiver is a body suspended in vacuum, with a piezo detector attached to it or interposed between segments of it, to sense mechanical oscillations in the receiver mass.

Verbitskiy, V. A., A. G. Grammakov, B. M. Kolomytsev, and G. S. Smirnov. Infrared radiometer for geologic mapping. IVUZ Priboro, no. 3, 1972, 110-111.

An infrared radiometer for noncontact thermal geologic mapping was developed and field-tested for motor vehicle and aircraft use. The radiometer compares the infrared self-radiation of the Earth's surface with the infrared radiation of a thermally stabilized standard black body which constitutes the reference emitter. The technical specifications are: field of vision angle - 45°, measured temperature range - 0 to +35°C; this limit is divided into three ranges to increase the resolving power of the radiometer: (0 - +15°C), (+10 - +25°C), (+20 - +35°C); temperature resolution - 0.1°C, measurement error under field mapping conditions - 0.3°C; a 24v dc self-contained power supply; and instrument weight - 6 kg. Testing of the

unit for 200 hours of operation in roadless terrain and at temperatures of +2 - +25°C yielded satisfactory results, with a calibrated deviation of less than 0.3°C.

B. Recent Selections

Afanas'yev, K. L., E. A. Bol'shakov, A. A. Garnaker'yan, and V. T. Lobach. Determining the polarization characteristics of radar signals reflected from the sea surface. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 193-196. (RZhRadiot, 9/72, no. 9G27)

Akulina, D. K., Yu. I. Nechayev, V. Ya. Sud'yenkov, and O. I. Fedyanin. Open microwave resonator measurement of stellarator plasma density. TVT, no. 4, 1972, 913-916.

Balaklitskiy, I. M., Ye. Ye. Moroz, A. A. Petrushin, O. A. Tret'yakov, and V. P. Shestopalov. Diffraction radiation generator. Otkr izobr, no. 24, 1972, no. 347834.

Balkarey, Yu. I., and L. N. Bulayevskiy. Effect of specimen boundary structure and domain walls on electrical properties of magnetic semiconductors. FTT, no. 8, 1972, 2407-2412.

Biryukov, Yu. L., and L. G. Titarchuk. Photometric measurements of particle scattering characteristics in Venus' atmosphere. Kosmicheskiye issledovaniya, no. 4, 1972, 576-579.

Bopp, G. A. Optical studies of concentrated sparks in liquids. IN: Uchenyye zapiski Moskovskogo zaochnogo PI, no. 30, 1971, 181-186. (LZhS, 37/72, no. 122155)

Bunin, V. A. A system for transmitting and receiving signals by means of gravity waves. Otkr izobr, no. 24, 1972, no. 347937.

Chernetskiy, A. V., A. A. Temeyev, S. M. Chernetskaya, and V. M. Lukanov. Calculation of plasma acceleration parameters in high frequency electric and static magnetic fields. IVUZ Avia, no. 2, 1972, 67-72.

Degtyarenko, G. A. Forecasting lower stratosphere wind fields with application to supersonic flight. IN: Trudy Vsesoyuznaya konferentsiya po voprosam meteorologicheskogo obespecheniya sverkhzvukovoy aviatsii, 1971. Leningrad, 1971, 76-81. (RZhMekh, 7/72, no. 7B969)

Dokuchayev, V. P. Theory of magnetoacoustic wave generation by mechanical radiators. ZhPMTF, no. 4, 1972, 31-41.

Grebinskiy, A. S. Method for antenna aperture synthesis. Otkr izobr, no. 22, 1972, no. 345555.

Grudinskaya, G. P., and Ye. V. Bogomolova. Ultrashort wave reflection from forest tops at angles of incidence near to normal. IN: X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 131-134. (RZhRadiot, 9/72, no. 9G22)

Iordanishvili, Ye. K., and B. Ye.-Sh. Malkovich. Experimental investigation of nonstationary thermoelectric cooling. III. Combined regime. I-FZh, v. 23, no. 3, 1972, 498-505.

Ivanov, A. P., I. I. Kalinin, A. L. Skrelin, and I. D. Sherbaf. Spatial-time structure of light pulses in water. FAiO, no. 8, 1972, 884-890.

Kalmykov, A. I., A. S. Kurekin, V. N. Lanovoy, V. Yu. Levantovskiy, and V. V. Pustovoytenko. Radiation directed polarization characteristics of sea surface signal scattering. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 158-160. (RZhRadiot, 9/72, no. 9G21)

Kalmykov, A. I., A. S. Kurekin, V. Yu. Levantovskiy, I. Ye. Ostrovskiy, and V. V. Pustovoytenko. Two-position radiowave scattering by a sea surface. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 161-165. (RZhRadiot, 9/72, no. 9G25)

Kanareykin, D. B., and V. A. Sarychev. Total scattering matrix for discrete radar targets. IN: X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 191-192. (RZhRadiot, 9/72, no. 9G23)

Kapitanov, V. A., Yu. V. Mel'nichuk, and A. A. Chernikov. Microwave radar signal spectra from forest surfaces. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 125-130. (RZhRadiot, 9/72, no. 9G19)

Kessel'man, O. L., L. Z. Klyachkin, V. F. Presnyakov, and V. M. Yudovin. Device for processing surveillance radar initial data. Author's certificate SSR, no. 318949, published 12/17/71. (RZhRadiot, 9/72, no. 9G11 P)

Kingsep, A. S. Role of nonlinear effects in a problem on anomalous resistance of plasma. ZhETF, v. 63, no. 2, 1972, 498-501.

Kramarenko, P. F. Ion transport of clear images under normal conditions. IVUZ Fiz, no. 8, 1972, 149-150.

Krupenio, N. N. Methods of spaceborne lunar and planetary radar. IN: Sbornik. Apparatura dlya kosmicheskikh issledovaniy. Moskva, Izd-vo Nauka, 1972, 30-42. (RZhRadiot, 9/72, no. 9G16)

Lidorenko, N. S., V. F. Lebedev, and V. A. Simonov. Highly effective thermoelectric batteries. IAN Energ, no. 4, 1972, 117-122.

Longinov, A. V. Longitudinal electric field excitation of plasma waves. ZhTF, no. 8, 1972, 1591-1605.

Lysykh, V. A., and V. N. Tatarinov. Hermitian form of statistical polarization parameters of electromagnetic scattering. IN: Sbornik. X Vsesoyuznaya konferentskiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 166-170. (RZhRadiot, 9/72, no. 9G29)

Medvedev, V. V., and M. A. Yevdokimov. Statistical model for scattering from simple shapes. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 87-91. (RZhRadiot, 9/72, no. 9G20)

Orlova, N. G. First All-Union Conference on Holography, May 1972, Tbilisi. (Review paper). TKiT, no. 9, 1972, 88-90.

Osadchiy, V. A., A. F. Piskunkov, and Yu. K. Szhenov. Characteristics of a cesium-barium thermionic converter at a high anode temperature. TVT, no. 4, 1972, 738-743.

Plasma drilling. (Book review: Thermal destruction of rocks by plasma drills, by E. A. Bergman and G. N. Pokrovskiy). Bakinskiy rabochiy, 7/27/72, p. 3.

Prokhorov, V. G. Piezoelectric matrices for registering acoustic images and holograms. Akusticheskiy zhurnal, no. 3, 1972, 482-484.

Rodimov, A. P., V. A. Potekhin, and A. P. Lantsov. Preliminary analysis of partially polarized signal characteristics. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 181-185. (RZhRadiot, 9/72, no. 9G18)

Rozenberg, A. D., V. I. Zel'dis, and V. G. Ruskevich. Spectra of signals scattered from a disturbed sea surface. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 97-101. (RZhRadiot, 9/72, no. 9G30)

Ryutov, D. D. "Diffusion" electrodes for investigating liquid dielectric breakdown. ZhPMTF, no. 4, 1972, 186-187.

Suslov, N. N., and V. P. Shestopalov. Diffraction radiation generator. Oktr izobr, no. 24, 1972, no. 347833.

Sysoyev, A. S., and O. A. Tret'yakov. Open resonators with a diffraction grating mirror. RiE, no. 9, 1972, 1951-1953.

Tuchkov, L. T., V. M. Vyatkina, D. B. Kanareykin, and Yu. N. Shchepkin. The "Tsunami" system for measuring reflectance of various shapes. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 153-157. (RZhRadiot, 9/72, no. 9G31)

Usikov, A. Ya., V. N. Kontorovich, E. A. Kaner, and P. V. Bliokh. Application of light pressure for selective gas scavenging. UFZh, no. 8. 1972, 1245-1248.

Vaysleyb, Yu. V., and Yu. E. Udal'yev. Evaluation of approximation methods of calculating pulsed radar scattering fields. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 30-33. (RZhRadiot, 9/72, no. 9G24)

Vakser, I. Kh., V. A. Komyak, and L. I. Sharapov. Measuring radar reflection from rainfall at 4.1 and 8.15 mm wavelengths. IN: Sbornik. X Vsesoyuznaya konferentsiya rasprostranenii radiovoln, Moskva, Izd-vo Nauka, 1972, 76-80. (RZhRadiot, 9/72, no. 9G32)

Yermakov, Yu. A. Resonance absorption of ion electromagnetic energy in a superfluidic helium vortex. ZhETF, v. 63, no. 2, 1972, 616-620.

Zagorodnikov, A. A., and K. B. Chelyshev. Correlation of radar image spatial spectra from ice fields with ice floe dimensional distribution. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 102-105. (RZhRadiot, 9/72, no. 9G28)

Zheleznyak, M. M., V. N. Kalachev, and V. A. Kashin. Theory of statistical synthesis of antenna arrays. RiE, no. 9, 1972, 1807-1815.

Zhilko, Ye. O., and A. A. Zagorodnikov. Correlation of spatial and time spectra of sea surface scattered signals with sea state parameters. IN: Sbornik. X Vsesoyuznaya konferentsiya po rasprostranenii radiovoln, Section 5. Moskva, Izd-vo Nauka, 1972, 106-110. (RZhRadiot, 9/72, no. 9G26)

SOURCE ABBREVIATIONS

AiT	-	Avtomatika i telemekhanika
APP	-	Acta physica polonica
DAN ArmSSR	-	Akademiya nauk Armyanskoy SSR. Doklady
DAN AzSSR	-	Akademiya nauk Azerbaydzhanskoy SSR. Doklady
DAN BSSR	-	Akademiya nauk Belorusskoy SSR. Doklady
DAN SSSR	-	Akademiya nauk SSSR. Doklady
DAN TadSSR	-	Akademiya nauk Tadzhikskoy SSR. Doklady
DAN UkrSSR	-	Akademiya nauk Ukrainskoy SSR. Dopovidi
DAN UzbSSR	-	Akademiya nauk Uzbekskoy SSR. Doklady
DBAN	-	Bulgarska akademiya na naukite. Doklady
EOM	-	Elektronnaya obrabotka materialov
FAiO	-	Akademiya nauk SSSR. Izvestiya. Fizika atmosfery i okeana
FGiV	-	Fizika goreniya i vzryva
FiKhOM	-	Fizika i khimiya obrabotka materialov
F-KhMM	-	Fiziko-khimicheskaya mekhanika materialov
FMiM	-	Fizika metallov i metallovedeniye
FTP	-	Fizika i tekhnika poluprovodnikov
FTT	-	Fizika tverdogo tela
FZh	-	Fiziologicheskiy zhurnal
GiA	-	Geomagnetizm i aeronomiya
GiK	-	Geodeziya i kartografiya
IAN Arm	-	Akademiya nauk Armyanskoy SSR. Izvestiya. Fizika
IAN Az	-	Akademiya nauk Azerbaydzhanskoy SSR. Izvestiya. Seriya fiziko-tekhnicheskikh i matematicheskikh nauk

IAN B	-	Akademiya nauk Belorusskoy SSR. Izvestiya. Seriya fiziko-matematicheskikh nauk
IAN Biol	-	Akademiya nauk SSSR. Izvestiya. Seriya biologicheskaya
IAN Energ	-	Akademiya nauk SSSR. Izvestiya. Energetika i transport
IAN Est	-	Akademiya nauk Estonskoy SSR. Izvestiya. Fizika matematika
IAN Fiz	-	Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya
IAN Fizika zemli	-	Akademiya nauk SSSR. Izvestiya. Fizika zemli
IAN Kh	-	Akademiya nauk SSSR. Izvestiya. Seriya khimicheskaya
IAN Lat	-	Akademiya nauk Latviyskoy SSR. Izvestiya
IAN Met	-	Akademiya nauk SSSR. Izvestiya. Metally
IAN Mold	-	Akademiya nauk Moldavskoy SSR. Izvestiya. Seriya fiziko-tekhnicheskikh i matematicheskikh nauk
IAN SO SSSR	-	Akademiya nauk SSSR. Sibirskoye otdeleniye. Izvestiya
IAN Tadzh	-	Akademiya nauk Tadzhiksoy SSR. Izvestiya. Otdeleniye fiziko-matematicheskikh i geologo-khimicheskikh nauk
IAN TK	-	Akademiya nauk SSSR. Izvestiya. Tekhnicheskaya kibernetika
IAN Turk	-	Akademiya nauk Turkmenskoy SSR. Izvestiya. Seriya fiziko-tekhnicheskikh, khimicheskikh, i geologicheskikh nauk
IAN Uzb	-	Akademiya nauk Uzbekskoy SSR. Izvestiya. Seriya fiziko-matematicheskikh nauk
IBAN	-	Bulgarska akademiya na naukite. Fizicheski institut. Izvestiya na fizicheskaya institut s ANEB
I-FZh	-	Inzhenerno-fizicheskiy zhurnal

IiR	-	Izobretatel' i ratsionalizator
ILEI	-	Leningradskiy elektrotekhnicheskiy institut. Izvestiya
IT	-	Izmeritel'naya tekhnika
IVUZ Avia	-	Izvestiya vysshikh uchebnykh zavedeniy. Aviatsionnaya tekhnika
IVUZ Cher	-	Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya
IVUZ Energ	-	Izvestiya vysshikh uchebnykh zavedeniy. Energetika
IVUZ Fiz	-	Izvestiya vysshikh uchebnykh zavedeniy. Fizika
IVUZ Geod	-	Izvestiya vysshikh uchebnykh zavedeniy. Geodeziya i aerofotos"yemka
IVUZ Geol	-	Izvestiya vysshikh uchebnykh zavedeniy. Geologiya i razvedka
IVUZ Gorn	-	Izvestiya vysshikh uchebnykh zavedeniy. Gornyy zhurnal
IVUZ Mash	-	Izvestiya vysshikh uchebnykh zavedeniy. Mashinostroyeniye
IVUZ Priboro	-	Izvestiya vysshikh uchebnykh zavedeniy. Priborostroyeniye
IVUZ Radioelektr	-	Izvestiya vysshikh uchebnykh zavedeniy. Radioelektronika
IVUZ Radiofiz	-	Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika
IVUZ Stroi	-	Izvestiya vysshikh uchebnykh zavedeniy. Stroitel'stvo i arkhitektura
KhVE	-	Khimiya vysokikh energiy
KiK	-	Kinetika i kataliz
KL	-	Knizhnaya letopis'
Kristall	-	Kristallografiya
KSpF	-	Kratkiye soobshcheniya po fizike

LZhS	-	Letopis' zhurnal'nykh statey
MiTOM	-	Metallovedeniye i termicheskaya obrabotka materialov
MP	-	Mekhanika polimerov
MTT	-	Akademiya nauk SSSR. Izvestiya. Mekhanika tverdogo tela
MZhiG	-	Akademiya nauk SSSR. Izvestiya. Mekhanika zhidkosti i gaza
NK	-	Novyye knigi
NM	-	Akademiya nauk SSSR. Izvestiya. Neorganicheskiye materialy
NTO SSSR	-	Nauchno-tekhnicheskiye obshchestva SSSR
OiS	-	Optika i spektroskopiya
OMP	-	Optiko-mekhanicheskaya promyshlennost'
Otkr izobr	-	Otkrytiya, izobreteniya, promyshlennyye obraztsy, tovarnyye znaki
PF	-	Postepy fizyki
Phys abs	-	Physics abstracts
PM	-	Prikladnaya mekhanika
PMM	-	Prikladnaya matematika i mekhanika
PSS	-	Physica status solidi
PSU	-	Pribory i sistemy upravleniya
PTE	-	Pribory i tekhnika eksperimenta
Radiotekh	-	Radiotekhnika
RiE	-	Radiotekhnika i elektronika
RZhAvtom	-	Referativnyy zhurnal. Avtomatika, telemekhanika i vychislitel'naya tekhnika
RZhElektr	-	Referativnyy zhurnal. Elektronika i yeye primeneniye

RZhF	-	Referativnyy zhurnal. Fizika
RZhFoto	-	Referativnyy zhurnal. Fotokinotekhnika
RZhGeod	-	Referativnyy zhurnal. Geodeziya i aeros''-yemka
RZhGeofiz	-	Referativnyy zhurnal. Geofizika
RZhInf	-	Referativnyy zhurnal. Informatics
RZhKh	-	Referativnyy zhurnal. Khimiya
RZhMekh	-	Referativnyy zhurnal. Mekhanika
RZhMetrolog	-	Referativnyy zhurnal. Metrologiya i izmeritel'naya tekhnika
RZhRadiot	-	Referativnyy zhurnal. Radiotekhnika
SovSciRev	-	Soviet science review
TiEKh	-	Teoreticheskaya i eksperimental'naya khimiya
TKiT	-	Tekhnika kino i televideniya
TMF	-	Teoreticheskaya i matematicheskaya fizika
TVT	-	Teplofizika vysokikh temperatur
UFN	-	Uspekhi fizicheskikh nauk
UFZh	-	Ukrainskiy fizicheskiy zhurnal
UMS	-	Ustalost' metallov i splavov
UNF	-	Uspekhi nauchnoy fotografii
VAN	-	Akademiya nauk SSSR. Vestnik
VAN BSSR	-	Akademiya nauk Belorusskoy SSR. Vestnik
VAN KazSSR	-	Akademiya nauk Kazakhskoy SSR. Vestnik
VBU	-	Belorusskiy universitet. Vestnik
VNDKh SSSR	-	VNDKh SSSR. Informatsionnyy byulleten'
VLU	-	Leningradskiy universitet. Vestnik. Fizika, khimiya
VMU	-	Moskovskiy universitet. Vestnik. Seriya fizika, astronomiya

ZhETF	-	Zhurnal eksperimental'noy i teoreticheskoy fiziki
ZhETF P	-	Pis'ma v Zhurnal eksperimental'noy i teoreticheskoy fiziki
ZhFKh	-	Zhurnal fizicheskoy khimii
ZhNiPFiK	-	Zhurnal nauchnoy i prikladnoy fotografii i kinematografii
ZhNKh	-	Zhurnal neorganicheskoy khimii
ZhPK	-	Zhurnal prikladnoy khimii
ZhPMTF	-	Zhurnal prikladnoy mekhaniki i teoreticheskoy fiziki
ZhPS	-	Zhurnal prikladnoy spektroskopii
ZhTF	-	Zhurnal tekhnicheskoy fiziki
ZhVMMF	-	Zhurnal vychislitel'noy matematiki i matematicheskoy fiziki
ZL	-	Zavodskaya laboratoriya

8. AUTHOR INDEX